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THE INCREMENTAL COST OF F/A-18F NAVAL FLIGHT OFFICERS

by

Robert A. Hunt

June 1997

Thesis Co- Advisors: Gregory E. Hildebrandt
John E. Mutty

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The dynamic method developed in this study not only considers the NFOs in the operational squadrons, but also includes all NFOs in the rotation base that are required to implement this decision. In addition, it considers the dynamics of change that will occur over time as F-14 NFOs transition to the F/A-18F. This dynamic method, rather than the current static method, provides a better estimate of the direct personnel costs associated with the implementation of an alternative. The improved estimate of costs could be an important part of a cost-effectiveness analysis.

This study recommends that the Navy continue to refine the methods of estimation developed in this study. A refined version of this method could provide future decision makers with improved estimates of personnel requirements and their costs.

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THE INCREMENTAL COST OF F/A-18F NAVAL FLIGHT OFFICERS

Robert A. Hunt
Lieutenant Commander, United States Navy
B.S., Radford University, 1979

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June 1997

Author: Robert A. Hunt

Approved by: Gregory G. Hildebrandt, Thesis Co-Advisor

John E. Mutty, Thesis Co-Advisor

Reuben T. Harris, Chairman
Department of Systems Management

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A. GENERAL DESCRIPTION

This thesis is a research study analyzing a change to the acquisition plan for the F/A-18E/F aircraft. As originally planned, the single-seat F/A-18E would have replaced the current F/A-18A, F/A-18C and F-14 fleets. The two-seat F/A-18F aircraft was to have been the training version of the F/A-18E. The Navy now plans to replace the F-14 fleet with the two-seat F/A-18F, while the F/A-18E will still replace the F/A-18A and F/A-18C. The objective of this thesis is to identify a portion of the differential costs that the Navy is likely to incur as a result of the change from the F/A-18E to the F/A-18F as the replacement for the F-14 fleet. Specifically, this thesis identifies those direct costs associated with the Naval Flight Officers (NFOs) required for the two-seat plan.

B. RESEARCH

1. Data Collection

Archival research provided data concerning aircraft delivery rates and dates, NFO manning and training requirements. Analytical research provided a projection of F/A-18F NFO career patterns from existing F-14 NFO career data.

2. Data Analysis

No historical data exist pertaining to F/A-18F NFO career paths, as the program is only in the developmental phase. This study used historical data from

the F-14 NFO community to develop a model that is likely to look like the career path of the typical F/A-18F NFO.

C. RESEARCH QUESTIONS

For the decision to change from the F/A-18E to the F/A-18F, this research addresses the following questions:

1. How many NFOs will be required to man the F/A-18F fleet in operational squadrons, in training and in the rotation base, throughout the life-cycle of the aircraft?

2. What are the direct costs associated with employing, training and retaining the NFOs required for a two-seat F/A-18F fleet?

D. THESIS OUTLINE

This thesis includes five chapters. Following this introduction, Chapter II covers the F/A-18E/F acquisition plan and provides some additional considerations relevant to the research. Chapter III details the methodology and assumptions used in this research. The fourth chapter presents the results of the research. The final chapter presents the conclusions and recommendations.

II. BACKGROUND

A. AIRCRAFT DESIGNATIONS

This thesis makes extensive use of aircraft designations. The following is a list and brief description of the aircraft designations used most commonly in this thesis.

1. F/A-18A – First fleet version of the single-seat, strike-fighter aircraft that performs both air-to-air and air-to-ground attacks.

2. F/A-18B - Two-seat training version of the F/A-18A. The front and rear cockpits are configured as pilot work stations.

3. F/A-18C - Second generation of the fleet's single-seat, strike-fighter aircraft. Employment similar to F/A-18A.

4. F/A-18D - Two-seat training version of the F/A-18C. Both cockpits are configured as pilot work stations. The Marine Corps recently purchased specially configured two-seat F/A-18Ds to be used in the Forward Air Controller Airborne mission. The rear cockpit of these Ds has been modified to accommodate the airborne forward air controller and is not configured as a pilot work station.

5. F/A-18E - Third generation single-seat strike-fighter currently under development by the Navy. Employment is expected to be similar to the F/A-18As and Cs.

6. F/A-18F - Two-seat version of the F/A-18E. It was originally planned as the training version of the F/A-18E, with the front and rear cockpits as pilot workstations. It is currently under development as a two-seat replacement aircraft for the F-14. This version of the F/A-18F will have the front cockpit configured as a pilot workstation and the rear cockpit as a Naval Flight Officer workstation.

7. F-14 - Two-seat fighter aircraft used for air-to-air combat. The front cockpit is the pilot workstation and the rear cockpit is the NFO workstation.

8. A-6E - Two-seat bomber aircraft used to attack surface targets. This aircraft has a side-by-side single cockpit, with the pilot workstation on the left side and the NFO workstation on the right side.

B. NAVAL AVIATION DESIGNATIONS

This study examines the direct costs associated with the Naval Flight Officers required to support a F/A-18F fleet. Since it deals extensively with NFOs and their designations, a brief introduction to Naval Aviation designations is provided here for those readers unfamiliar with these matters.

The Naval Air Warfare Community consists of pilots, Naval Flight Officers and aviation generalists. Pilots are trained to fly Naval aircraft. Naval Flight Officers are trained to operate the weapons and sensor systems of Naval aircraft. Aviation generalists serve in positions related to aviation but are not qualified to perform aircrew duties.

All pilots and NFOs begin their Naval aviation career training at the Aviation Schools Command in Pensacola, Florida. In general, the aviation candidate has made the decision to pursue a Naval career as either a pilot or a NFO well before actually arriving in Pensacola. This decision is based on personal interest, aptitude, medical qualifications, and the needs of the Navy.

After a brief and intense indoctrination to Naval Aviation, the training paths of pilots and NFOs diverge. Pilots attend flight school, learn to fly and eventually are awarded their "Wings of Gold" when designated Naval Aviators. Following

designation as Naval Aviators, the pilots enter the appropriate Fleet Replacement Squadron (FRS) where they learn to fly the particular aircraft they will fly in the fleet. Upon graduation from the FRS, the pilots are designated as pilots of that particular type of aircraft, such as F-14 Pilots or F/A-18 Pilots. They then enter their first fleet squadron.

After aviation indoctrination, all student NFOs enter a common training curriculum. During this training, students are selected for the various aircraft that employ NFOs. Each different type of aircraft requires different skills of its NFOs. So the NFOs intended for one aircraft receive slightly different training than the NFOs intended for another aircraft. At the completion of this "undergraduate" training, the candidates are designated Naval Flight Officers and are awarded their "Wings of Gold." The newly designated NFOs then attend the FRS for their aircraft type. Upon completion of this "graduate" training, they are designated with the specific title appropriate to their aircraft. For example, F-14 NFOs are designated Radar Intercept Officers (RIOs), A-6 NFOs are designated Bombardier Navigators (BNs), and F/A-18F NFOs will be designated Weapons Systems Officers (WSOs). They then enter their first fleet squadron.

The designations Naval Flight Officer and Naval Aviator are permanent designators for the officer. In general, a NFO will be a NFO for his or her entire Naval career. An aviator will be an aviator for his or her entire Naval career. This

is true regardless of current duty assignment. Whether in a desk job, in school, or serving on a staff, a NFO is still a NFO.

The same is true for NFO and pilot aircraft designations. For instance, a F-14 RIO will always be a RIO, in any duty assignment, whether employing his or her skills as a NFO or not. This individual will be a RIO until he or she transitions to another aircraft type. Generally, this only occurs if one's current aircraft is being retired from Naval service. If transitioning to another aircraft type, the NFO will attend the FRS for that aircraft. When the NFO graduates from that FRS, he or she would be designated with the title appropriate to that aircraft, such as RIO or BN.

C. THE F/A-18E/F ACQUISITION PLAN

On May 12, 1992, the Under Secretary of Defense for Acquisition approved the Navy's October 1991 request to develop the F/A-18E/F as a major modification of the existing F/A-18C/D [Ref. 1]. The Navy based its request on its determination that the Navy needed an upgraded carrier-based, multi-role aircraft that could perform both air-to-air and air-to-ground missions. All three of the Navy's carrier-based fighter or attack aircraft – the F-14, the A-6E, and the F/A-18A/C - will reach the end of their fatigue lives shortly after the turn of the century.

Due to budget constraints, the Navy plans to reduce the number of carrier-based tactical aircraft from three types to two. The Navy decided to develop the F/A-18E/F to eventually replace both the F/A-18A/C and the F-14, and to develop an entirely new aircraft, the A/FX[1], to replace the A-6E. In April 1991, the Navy evaluated the Grumman Aircraft Company's proposal to build a variant of the F-14 aircraft as a competitor to the F/A-18E/F. Between receipt of the Grumman proposal and approval for the F/A-18E/F program in May 1992, the Navy made several cost and technical comparisons of the Grumman proposal and the F/A-18E. The Navy used only the F/A-18E in its comparisons since it did not intend to use the F/A-18F operationally [Ref. 2].

The Under Secretary's Acquisition Decision Memorandum (ADM) of May 1992 authorized entry of the E/F into Engineering and Manufacturing Development (EMD), subject to the submission of a fully funded F/A-18E/F program. This program involved F/A-18Es as operational fleet aircraft and F/A-18Fs as trainers. A provision in the ADM required the submission of the Navy's A/FX Cost and Operational Effectiveness Analysis (COEA), evaluating both the F/A-18E/F and F/A-18C/D as alternatives.

In June 1992, the Department of Defense (DOD) Inspector General criticized the Navy for not preparing a COEA to demonstrate that the F/A-18E/F is

[1]This program became the A-12 program, which was eventually dropped due to cost overruns and technical problems.

the most cost-effective solution to a recognized military need. The Inspector General later reported that the Navy's A/FX aircraft COEA, dated November 19, 1992, comparing the F/A-18E/F to both the F/A-18C/D and the proposed A/FX aircraft, satisfied his earlier concerns. In December 1992, the Navy did perform a F/A-18E/F COEA using information and analysis from the A/FX COEA. The General Accounting Office (GAO) characterized this COEA as "limited." The GAO contended that acquisition regulations required the Navy to consider alternative ways to perform missions before approving a development effort. Navy officials disagreed with this characterization, stating that the Navy had considered a number of fixed-wing aircraft including the A/FX, the F/A-18C/D, the F-22 and the A-6E. These comparisons also considered the F/A-18E the operational version of the airframe and the F model as the trainer.

Meanwhile, in July 1992, the Navy awarded the McDonnell Douglas Aircraft Company a sole-source contract to develop the F/A-18E/F. The original procurement schedule through FY 2004 included the procurement of 161 F/A-18Es and 42 F/A-18Fs. Test and development required the first few F/A-18Es. Building the training squadrons and replacing the F/A-18As and Cs and the F-14 squadrons as those aircraft reached retirement would involve the remainder of the F/A-18Es. The Navy intended to use the 42 F/A-18Fs for infrastructure, with 37 of those 42 for the training squadrons, three for test and development, and two for

pipeline requirements. The total projected aircraft build was 1000, with 820 Es and 180 Fs.

In CY 1995, the Navy began considering replacing the F-14 fleet with the two-seat F/A-18F instead of the single seat F/A-18E [Ref. 3]. By October 1995, there was an initiative in the Program Objectives Memorandum 98 (POM 98) to transition ten F-14 fleet squadrons to F/A-18F aircraft [Ref. 4]. This would provide the Navy with carrier air wings consisting of 14 F/A-18Fs and 36 F/A-18Es. This air wing would move toward the carrier air wing of the early 21st century. The early 21st century air wing will consist of 14 F/A-18F and 36 F/A-18E/Joint Strike Fighter (JSF) aircraft. The current plan for aircraft builds is 1115 total F/A-18E/Fs, with 744 F/A-18Es and 371 F/A-18Fs. At the time research for this thesis was concluded, this was the current plan, as delineated in Procurement Objective 1115 [Ref. 5]. The Navy has developed an Operating and Support Life Cycle Cost estimate that reflects this mission change [Ref. 6].

D. FLEET REQUIREMENTS

The Operational Requirements Document (ORD) for F/A-18E/F [Ref. 7] contains the mission requirements for these aircraft. It cites the current F/A-18 as having

> proven its value to the Battle Group Commander by providing the capability to prosecute multiple missions under dynamic wartime conditions [Ref. 7].

Preplanned Product Improvements (P3I) to the current airframe have substantially improved the warfighting capability of the carrier air wing and Marine air wing. Preplanned Product Improvements provide for advancements in technology, airframe modifications and weapons systems upgrades.

These upgrades have, however, pushed the current F/A-18 near its carrier suitability weight limits. The carrier suitability weight limit of an airframe is the designed weight above which the aircraft is prohibited from landing aboard the carrier. It is therefore the maximum allowable weight of the aircraft when it lands on the carrier. An aircraft's carrier suitability weight includes everything in and on the aircraft. This includes fuel, ordnance and the basic weight of the aircraft. The difference between its basic weight and its carrier suitability weight provides for recovery fuel and unexpended, recoverable ordnance.

Preplanned Product Improvements not only increase capabilities of the aircraft, but they often increase the basic weight of the aircraft. Preplanned Product Improvements effectively move the basic weight of the aircraft closer to its carrier suitability weight. This reduces the weight margin available for recovery fuel and ordnance.

This continued basic weight increase toward the carrier suitability weight has stagnated the aircraft's capability to incorporate further P3I modernization programs. Lack of a replacement airframe and the approaching end of the current

F/A-18 fleet's service life would force the Navy to purchase additional F/A-18C/Ds that would already be at or very near their carrier suitability weight limits. This would prevent the employment of future P3I in those aircraft and would eventually lead to the fleet's inability to counter the postulated threat.

The ORD notes additional shortcomings of the existing F/A-18. Among those shortcomings is its unrefueled mission radius. The ORD states that the unrefueled mission radius of the current F/A-18 will not support long range strikes against high value land and sea targets. The ORD further indicates that the current F/A-18's combat performance is marginal against current threat fighters and will be insufficient against future threat fighters in both subsonic and supersonic flight regimes. This shortfall in performance is due both to the weight growth of the current F/A-18 caused by P3I and to the increased capabilities in combat performance attained by the threat since the F/A-18 was designed.

The ORD also lists pilot situational awareness as a concern in the current F/A-18. Tactical information has grown rapidly in complexity and quantity. This is due to multiple advancements in technology, including improvements in weapons, sensors and Multi-Source Integration. The assimilation of this information in high workload environments approaches the limits of the ability of the F/A-18 pilot to maintain situational awareness. The current F/A-18 will not be capable of using additional tactical information to improve mission success and aircraft survivability without upgrading crew station displays.

These factors, when considered together, indicate the need for a more capable airframe to replace the current F/A-18. According to the ORD, the Fleet Commanders In Chief (CINCs) highest priority for the F/A-18 replacement and the F/A-18 Operational Advisory Group's number one hardware priority is increased internal fuel. The postulated threat mandates improvements in mission radius and payload, carrier recovery payload, survivability and vulnerability.

The Navy believes the F/A-18E/F will provide the Carrier Battle Group Commander with a much improved multi-mission capable airplane. The primary mission areas of these aircraft will cover virtually every warfighting capability. The ORD now states that the upgrade must include both single-seat and dual-seat versions to support Navy requirements. The dual-seat version will provide the same number of capabilities as the F/A-18E in all mission areas. It will also provide an increase in warfighting capability in those mission areas that demand high cockpit task loading and those in a dense threat environment. Suppression of Enemy Air Defenses, Tactical Air Controller Airborne and Forward Air Controller Airborne, and Airborne Reconnaissance are all missions in which a two-seat crew brings significant additional capabilities.

In two-seat Naval aircraft, mission tasks are divided between the pilot and NFO. In general, the pilot's basic responsibility is to fly the aircraft and position it such that the assigned mission can be accomplished. The NFO's basic responsibility is employment of the aircraft's sensors and weapons systems. This

division of labor allows each crew member to concentrate on his or her assigned tasks. When there are many tasks to accomplish during a mission, such as those missions mentioned above, this division of labor often increases the quantity and complexity of tasks that can be accomplished. This often leads to an increase in overall capabilities. Although automation and technological advancements have made many tasks easier than they once were, these advancements have still not overcome some of the advantages offered by having two officers working together to accomplish a mission. Given comparably equipped single-seat and dual-seat aircraft, charged with destroying a target that is difficult to acquire and heavily defended, the capability and survivability scales often still tip in favor of the aircraft with two brains and two sets of eyes.

E. ADDITIONAL CONSIDERATIONS

1. Capabilities and Costs

Military and civilian aviators along with scholars and technicians have long debated the question, "Which aircraft is better, single-seat or multi-seat?" This is a multi-faceted debate, and there are as many different opinions concerning this topic as there are people involved in the debate. Groups and individuals alike have conducted countless studies to answer this question, yet the debate continues.

As directed by Defense Secretary Cohen and probably as part of the ongoing 1997 Quadrennial Review, decision makers will become involved in this

debate again. They will be taking another hard look at the F/A-18E/F program, along with the F-22 and the JSF [Ref. 8]. Faced with increasing budget constraints, decision makers may reconsider this decision to replace the F-14 with the more expensive dual-seat version of the F/A-18 upgrade. They should consider the proposed increased capabilities of the F/A-18F over the F/A-18E versus the proposed threat[2]. Additionally, however, the decision makers must consider the cost involved to obtain that increased capability.

When two very similar airframes, like the F/A-18E and F, are the subjects of such a debate, some of the involved costs are monetary in nature while others are not. Those costs that are not monetary in nature are often the most difficult to quantify, and therefore are often the very center of the debate.

Consider the following example, provided to illustrate the difficulty of such a debate. In the case of the F/A-18F versus the F/A-18E as the replacement for the F-14, the debate would involve very similar airframes. Any increase in capability that one model may offer over the other comes only when the first model sacrifices some of its capability. For instance, the F/A-18E/F ORD indicates that the two-seat model offers an increase in tactical capabilities during high cockpit workload situations over the single-seat model. The presence of the second crew-person provides that increased capability. That increased capability unfortunately comes

[2]Conger, Senior Program Analyst, RAIL Company, provides as excellent comparison of the F/A-18E and F capability considerations is his work "F/A-18F Missionized Rear Seat Study," 29 September 1995 [Ref. 9].

at the cost of a decrease in internal fuel capability. This decrease in internal fuel capability is due to the encroachment on internal fuel space by the additional crew station in the two-seat version. With less internal fuel than the single-seat version, the two-seat version will accordingly have a smaller unrefueled mission radius than the single-seat version. Such a decrement to its unrefueled mission radius could prevent the two-seat aircraft from ever getting to the point in the battlespace where it could use its increased capabilities. That is, after all, one reason the ORD listed increased internal fuel as the CINCs' top priority for this upgrade. Somewhere during this round of the "which is better" debate, however, the desire to further increase the mission capabilities of the upgrade has overridden the previous top priority for the upgrade. This has led decision makers to trade off internal fuel capability for the additional crew station.

This example is not intended to call into question a decision made concerning this particular issue. Certainly the decision makers considered a multitude of other factors in reaching their decision. This example is provided only to illustrate the ever increasing complexity of the non-monetary issues involved in any debate concerning "single-seat versus multi-seat" aircraft. These, and many other complex issues, are addressed in formal cost-effectiveness analyses.

It should be noted, however, that portions of any such increase in capabilities will cost dollars also. Decision makers should consider those costs

too. The Center for Naval Analyses addressed this consideration of costs in an Occasional Paper in November 1994 [Ref. 10]. It explains, with respect to the alternative systems to be considered, that what generates the costs relevant to an analysis of the alternatives are not just the systems themselves but implementation of the courses of action required to adopt one or more of the competing systems.

In the cost analysis of these two alternatives, differences are evident. The summation of all differences between the two alternatives is demonstrated in Figure 2.1.

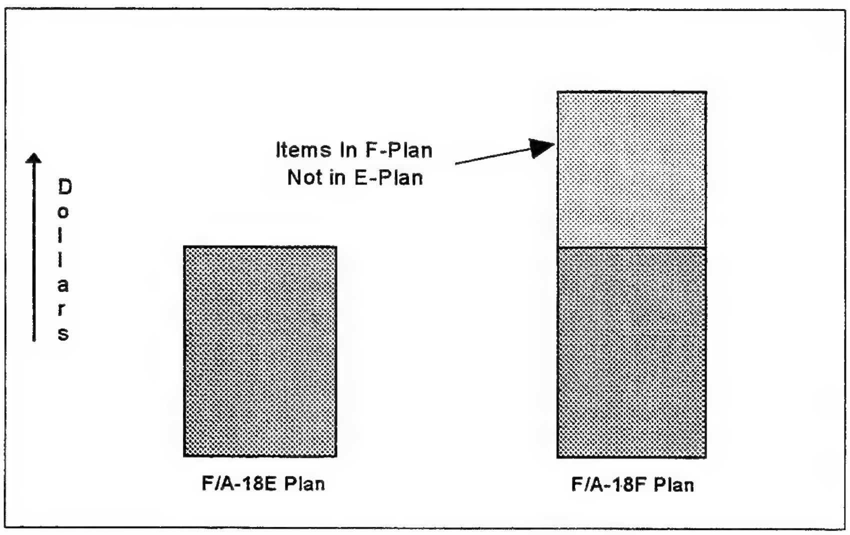

Figure 2.1. Incremental Cost of New Plan
(Not to scale; for illustrative purposes only)

These differences occur in three main categories. The first occurs due to the physical differences between the two airframes, the systems themselves. The second is due to the differences between maintenance and support costs of the two

airframes, a portion of the implementation of the alternatives. The third cost difference is due to the differences between the manning requirements for the two airframes, another portion of the implementation of the alternatives. The cost differences between the single-seat and dual-seat airframes and their associated maintenance and support requirements are readily identifiable. The cost difference due to the differences in manning requirements between the two airframes is not so easy to isolate.

Consideration of the summation of these and other costs, including peace-time attrition and combat loss rate differences and implications, are some of the tasks performed in formal cost analyses. This thesis is not a cost-effectiveness analysis between alternatives. This thesis seeks only to estimate a portion of one area, for one alternative, that would be considered in such a cost-effectiveness analysis. In particular, it concentrates on the direct personnel costs associated with the NFO requirement of the two-seat model F/A-18F, costs that are not present in the single-seat model F/A-18E that the Navy had originally intended to use as a replacement for the F-14. Figure 2.2 portrays the relationship of these costs.

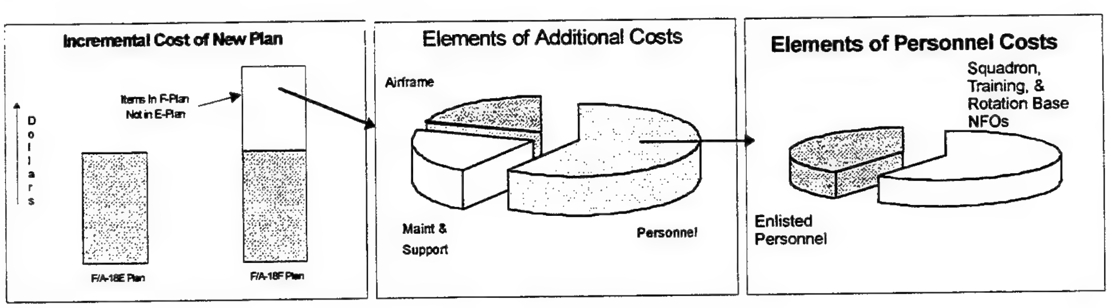

Figure 2.2. NFO Costs as a Portion of Total Incremental Cost

2. Personnel Considerations

This section provides several comparisons between the current F-14 fleet and the two alternatives, the F/A-18E and the F/A-18F. Recall that the original plan was to replace F-14 squadrons with single-seat F/A-18E squadrons and that the current plan is to replace F-14 squadrons with two-seat F/A-18F squadrons.

The current F-14 fleet is authorized to have 222 NFOs in the squadrons [Ref. 11]. Under the original plan, the single-seat F/A-18E fleet that replaced the F-14 fleet would have had no NFOs. As currently planned, the two-seat F/A-18F fleet will be authorized to have 220 NFOs in the squadrons [Ref. 6].

The above NFO numbers represent a 100 percent manning level in each type of squadron. The 100 percent manning level is the number of personnel, in this case NFOs, required for the airframe in a combat environment. Since that is the maximum number of personnel that would ever be required in the squadron for a particular airframe, it is the number used in Manpower Estimate Reports as the baseline for requirements.

Actual squadron manning levels are seldom 100 percent. Due to budget considerations, they are somewhat less than 100 percent. Actual manning levels vary not only from squadron to squadron but vary during the work-up and deployment cycles of a squadron. This study uses the 100 percent manning level instead of the actual manning level for three reasons. First, the Navy has not

determined actual manning levels for the future F/A-18E and F squadrons. Second, actual manning levels for the F-14 squadrons that will transition are unpredictable at this time. Third, since the 100 percent manning level for each squadron is a common baseline present in all squadrons, it is determinable, predictable and not variable.

Several comparisons are made here that are useful in the following discussions. First, under the original plan, the current F-14 fleet with 222 NFOs would have transitioned to F/A-18E squadrons with no NFOs. That would have been a decrease in requirements of 222 personnel.

Second, under the current plan, two-seat F/A-18F squadrons with 220 NFOs will replace F-14 squadrons with 222 NFOs. That is a decrease in requirements of two personnel.

Last, under the current plan, two-seat F/A-18F squadrons with 220 NFOs will replace the F-14 squadrons. That is an increase in requirements of 220 personnel over the original plan of no NFOs in the F/A-18E squadrons.

The author maintains that, when the Navy decided to replace the F-14 with the two-seat alternative instead of the single-seat alternative, it accepted the implied increase in personnel required to support the two-seat alternative over the original single-seat alternative. The Navy originally chose the alternative that decreased its NFO requirement by 222 personnel. During the four years the Navy spent developing this plan, it seems reasonable to assume that the Navy at least

began planning to adjust its personnel numbers in aviation or overall end strength to reflect that decrease. However, five years into development, the Navy changed that decision and chose the alternative that increased its requirements for NFOs by 220 personnel over its previous plan. Therefore, the 220 NFOs in the two-seat alternative that were not required in the original single-seat alternative are considered by this thesis to be "additional personnel."

With that point of view in mind, it is useful to examine two popular debates concerning such "additional personnel." This thesis does not seek to resolve either debate. It intends only to acknowledge their existence and relevance.

The first debate concerns maintaining the current status quo. Some contend that since the Navy currently employs the personnel required to support the two-seat F-14, replacing the F-14 with another two-seat aircraft simply means maintenance of the current status quo. The personnel who are flying and maintaining F-14s now will fly and maintain F/A-18Fs following the transition.

This point is not contested by this study. Replacing F-14s with F/A-18Fs does maintain the current status quo, basically. It is the author's contention, however, that the original plan presented by the Navy and approved by the Under Secretary of Defense for Acquisition in 1992 would not have maintained the status quo. It would have resulted in a reduction of 222 NFOs. Now the current plan calls for the continued service of 220 of those NFOs. That is a difference of 220

NFOs between the originally approved plan and the current plan. This is shown in Figure 2.3.

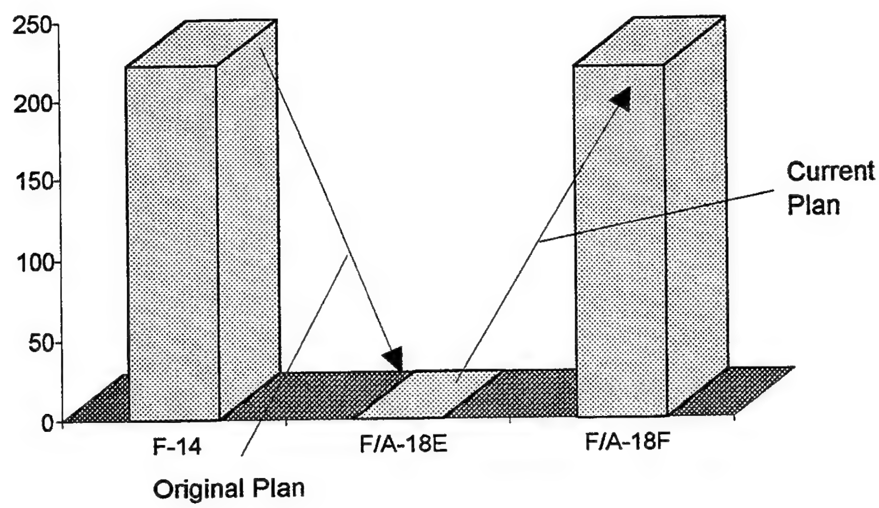

Figure 2.3. NFO Requirements

Given this position on the first debate, the second debate becomes relevant. This debate involves the maintenance of the Navy's end strength numbers and poses two points for consideration related to this thesis. In some sense, these two points are opposite sides of the same coin.

First, consider those personnel involved in the transition from F-14s to single-seat F/A-18Es under the original plan. As each F-14 squadron transitioned, there would be NFOs from the previous F-14 squadron not required in the new F/A-18E squadron. What would have become of those personnel? In the short

term, some may have transferred to the remaining F-14 squadrons, transitioned to other aircraft, or filled staff or instructor billets. This may have allowed some of those NFOs to remain in the Navy in the short-run. In the long-run, however, the principles of right-sizing would indicate that Naval Aviation would realize a decrease in personnel numbers. This decrease would be due to a smaller number of personnel required to man the F/A-18E squadrons versus that required to man the F-14 squadrons they replaced.

It is debatable whether overall Navy end strength would reflect this decrease in required aviation personnel or not. It is possible that, given time, other Navy communities, such as the surface, subsurface or medical service communities, would absorb personnel numbers no longer required in Naval Aviation. This would maintain Navy end strength. It is also possible, given right-sizing and continued fiscal constraints, that the other Naval communities are properly manned or fiscally constrained, and thus could not absorb additional personnel. In that case, the Navy would realize a reduction in end strength. In either case, after some period of time following the replacement of F-14s with single-seat F/A-18Es, the Navy's end strength would have been some number, X.

Now, consider the other side of this coin. Now that the Navy has changed its plan, from needing no F/A-18 NFOs to needing 220 F/A-18 NFOs, where will those additional 220 personnel come from? Will the Navy increase its overall end strength, or will it move personnel numbers from other communities into aviation?

In other words, the Navy's end strength under the single-seat plan would eventually have been X, as described above. Under the current two-seat plan, the end strength will be some number, X + Y, where Y represents all the NFOs required to support the new plan. Does Y represent an increase in overall Navy end strength? If not, then Y represents the number of personnel that other Naval communities must forfeit to Naval Aviation. If overall end strength is to be maintained and more personnel are required in the aviation community, personnel numbers from other communities must be moved into aviation. So, which communities can afford to decrease their personnel numbers?

Finally, one must understand that the 220 NFO figure used in the above illustrations only includes those NFOs actually in the squadrons. The Navy must employ many more than 220 NFOs in order to support that NFO requirement.

For instance, the F-14 fleet is currently authorized 222 RIOs, at 100 percent manning. Current funding provides for about 80 percent squadron manning. Due to deployment cycles, squadron training cycles and other such matters, the actual manning in the squadrons averages about 70 percent. This means that 70 percent of the authorized 222, or 156, F-14 RIOs are in the squadrons. The Navy currently has 593 F-14 RIOs on active duty [Ref. 12]. If 156 are actually in the

squadrons, then 437 are in non-operational tours.[3] That is a 2.8 to 1 ratio of support to squadron RIOs. A similar comparison to the F/A-18F fleet of tomorrow would indicate that the Navy will employ 586 F/A-18F NFOs during any one given year in order to provide 154, or 70 percent of the required 220 NFOs to the squadrons. Based on a weighted average of composite salary rates for the squadron NFOs in FY97 dollars, an estimate for those 586 NFOs is over $43 million in salary, per year[4]. Plus, these estimates do not include prospective RIOs in undergraduate flight training.

When considering a Naval force of some 385 thousand personnel, an additional 586 personnel or $43 million per year is only a small percent of total end strength or the Navy's budget. Keep in mind, however, that this is only one portion of the cost increase that resulted when the Navy changed from the single-seat alternative to the two-seat alternative. There are many other additional costs.

This thesis includes the previous discussions only to acknowledge the existence of some very complex issues surrounding the implementation of this decision. The research required to address end strength issues and answer these

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[3]All positions filled by NFOs that are not in a fleet squadron are considered non-operational tours in this thesis. These tours include but are not limited to staff duty, the test pilot program, postgraduate school, base and ship's company tours, and flight instructor tours. Flight instructor tours include tours in the FRS and in the undergraduate squadrons.

[4]Composite Standard Military Rates taken from the Operating and Support Life Cycle Cost Estimate for the F/A-18E/F [Ref. 6], which obtained the rates from the Defense Finance And Accounting Service Memorandum dated 01 October 1996. These composite rates include base pay, all allowances, and an allowance for the retirement annuity.

questions is beyond the scope of this thesis, but offers opportunities for further study.

To conclude this chapter, a quick summary of this study's position regarding personnel issues and a reconfirmation of the purpose of this thesis is in order. The author maintains that, given the Navy decided to replace the F-14 with the two-seat alternative instead of the single-seat alternative as originally planned, the direct effect of that decision is an implied increase in personnel required to support the two-seat alternative over the single-seat alternative. It might not be appropriate to consider these "additional personnel" related costs in the same vein as the costs associated with a different or additional piece of hardware. The Navy could immediately avoid such hardware costs by not purchasing the hardware. Whether these direct personnel costs are avoidable or not is debatable. These additional personnel requirements may lead to other personnel adjustments. These other adjustments, however, would result from other decisions. The direct personnel costs of the change to the F/A-18F represent a cost to the Navy and should be included in the acquisition plan for this airframe. As such, in these times of increasing budget constraints and continued scrutiny of large acquisition programs, these direct costs must be identified and considered.

III. METHODOLOGY AND ASSUMPTIONS

A. BASIC METHODOLOGY

There are several ways to represent the objective of this thesis, identifying those direct costs associated with the NFOs required for the two-seat plan. One popular way is to determine the number of NFOs required in one squadron, compute their salary, and then multiply that cost by the number of squadrons that will transition, in this case, ten. This is called a "static" or annual representation since it only includes the cost of NFOs required at one point in time. This cost estimate is useful to planners and budgeters in calculating annual expenditures, but it is misleading if used by decision makers when comparing alternatives. Decision makers might believe that the direct costs associated with the NFOs required for the two-seat plan are simply this annual figure multiplied by the 20 year life-cycle of the airframe.

A more accurate representation of these costs is possible. A "dynamic" representation of these costs would also consider the NFOs required to establish the rotation base for the squadron NFOs and the effects of the transition process over time on the squadron and rotation base NFOs. Such an approach would provide a more accurate estimate of this portion of the total differential costs the Navy is likely to incur as a result of the NFO requirement.

Therefore, this study includes those personnel necessary to provide the rotation base for the squadron personnel. It also considers the dynamics of change associated with the transition of squadrons.

The estimates provided by this study are based on a notional NFO career path and a notional F/A-18F squadron. That career path was combined with the life-cycle of the aircraft to determine the number of NFOs required in the rotation base. The effects of the F-14 NFO transitions were then considered, which provided the numbers necessary to compute their training costs. Consideration of the F-14 NFO transitions also established the number of new NFOs required to complete the life-cycle. The costs, in FY97 dollars, were then estimated by totaling the cost of all training and applying the salary rates of new WSOs required by this plan throughout their careers. All cost estimates are therefore in FY97 constant dollars.

It should be noted that, in providing estimates in constant FY97 dollars, this study does not consider the effects of inflation or salary raises over the extended period of time considered in this study. Those factors are not included due to the high degree of uncertainty associated with predicting them over such extended periods. The estimates provided by this study would be significantly larger had these factors been taken into account.

Additionally, the estimates provided by this study have not been discounted to their net present values. Net present value is the discounted monetized value of

expected net benefits, or benefits minus costs. Net present value is the standard criterion for deciding whether a Government program can be justified on economic principles. The Office of Management and Budget (OMB) Circular Number A-94 [Ref. 13] provides guidance on the use of net present value discounting for cost-effectiveness analyses. The Circular directs the use of present value discounting when performing cost-effectiveness analysis of Federal programs or policies.

> Cost-effectiveness analyses are indicated whenever it is unnecessary or impractical to consider the dollar value of benefits provided by the alternatives under consideration [Ref. 13].

The benefits offered by the F/A-18F certainly fit into this category. However, this study is not an attempt to perform a cost-effectiveness analysis, nor does it expect to contribute to a determination of whether this program can be justified on economic principles. Those analyses have already been performed and the determinations have already been made. The intention of this study is to identify one portion of the implementation costs of an alternative already chosen.

If, however, a refined version of this estimation method were used to provide costs for inclusion in some future cost-effectiveness analysis, discounting to net present value of its estimates would be required. It is not required for the purposes of this thesis.

B. NAVAL FLIGHT OFFICER CAREER PATH MODELING

Since the F/A-18E/F program is still in the developmental phase, there are no historical data concerning the F/A-18F NFO career path to use in this study. Therefore, this study uses the F-14 NFO career path as the pattern for the F/A-18 NFO career path. The primary reason for using the F-14 NFO pattern is the F-14 and the F/A-18F are crewed alike, with one pilot and one NFO. It is logical to assume that the career paths for similarly crewed aircraft will be similar.[5]

In this thesis, the notional NFO career path begins with undergraduate flight training [Ref. 16]. This point of origin avoids the ambiguities associated with the Navy's intentions to maintain aviation or overall end strength numbers discussed in Chapter II of this work. This point of origin does, therefore, exclude recruitment and initial officer training costs that might be associated with these "additional personnel." A determination of the end strength implications of a decision like the one considered in this thesis, coupled with an identification of the accession costs of these "additional personnel," could further refine the estimates provided by this study.

Recall that all NFOs attend basic flight training in Pensacola, Florida. Those NFOs selected for the F-14 pipeline complete their undergraduate flight

[5]To confirm this, the author contacted the F/A-18E/F Fleet Replacement Squadrons Plans Officer and the Aviation Community Manager [Refs. 14 and 15].

training in Pensacola. The F/A-18 NFOs' training will follow a very similar path to this point.

The F-14 NFOs then attend graduate flight training in the F-14 Fleet Replacement Squadron. Upon graduation, the F-14 NFOs are designated Radar Intercept Officers. The F/A-18 NFOs will receive their graduate flight training at the F/A-18E/F FRSs. Upon completion of training in the F/A-18E/F FRS, F/A-18 NFOs will be designated Weapons Systems Officers [Ref. 14].

Following graduation from the FRS, the WSOs will join their first fleet squadron. At that point, the traditional aviation career path begins. This study uses the traditional aviation career path, built on three year rotations, as the normal NFO career path.[6]

The Office of Officer Promotion Plans provided current officer promotion dates and rates [Ref. 19]. This information allowed the study to account for officer promotion and separation considerations during the WSO's career.

This study follows those three year rotations and promotions throughout the career of each WSO to its logical conclusion. The conclusion of the WSO's career will occur according to Navy guidelines, described later in this work.

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[6]A current aviation officer detailer and a current F-14 NFO confirmed this typical rotation schedule [Refs. 17 and 18].

C. THE WEAPONS SYSTEMS OPERATOR CAREER PATH

1. Officer Ranks

A brief and very general introduction to Naval Officer ranks and advancement timing is provided here to facilitate understanding the following WSO career path presentation. The rank of 06, and 30 years of service are the maximum rank and time in service included in this study. A section under Assumptions, later in this work, addresses the use of these maximums.

Naval Officers are Ensigns, of the pay grade 01, generally referred to as 01s, for the first two years of their service following commissioning. They are automatically advanced to Lieutenant Junior Grade, or 02s, after two years of service, barring any adverse occurrences during those first two years of service. After two years of service as 02s, they are advanced to Lieutenant, 03s, again barring any adverse occurrences during the past two years. Therefore, service as a Lieutenant begins after four years of service.

Lieutenants' records are reviewed after nine years of service for selection to Lieutenant Commander, 04. If not selected on their first review, their records are reviewed again the next year. If not selected for 04, they will leave the Navy within approximately one year. If selected for 04, they will be promoted to 04 after approximately ten years of service.

Lieutenant Commanders' records are reviewed after 14 years of service for selection to Commander, 05. If not selected on their first review, their records are reviewed again the next year. If not selected for 05, they may remain in the Navy until they have served 20 years. If selected for 05, they will be promoted to 05 after approximately 15 years of service.

Commanders' records are reviewed after 20 years of service for selection to Captain, 06. If not selected for 06, they may remain in the Navy until they have served 28 years. If selected for 06, they will be promoted to 06 after approximately 21 years of service.

2. The Weapons Systems Operator Notional Career Path

This study uses the following notional career path for the WSOs considered in this study. The assumptions necessary to generalize all the different actual career paths that might occur into this notional career path are explained later in this work.

Undergraduate and graduate flight training will take a total of two years. This means that the newly graduated WSO arrives at his or her first fleet squadron as a new 02. This tour will normally last three years. During the tour, those 02s will become 03s. The 02s and 03s in the squadron are called the Junior Officers, or JOs.

Following this initial operational squadron tour, the JOs will spend three years in a shore tour. They will be 03s throughout that entire tour.

Following this shore tour, the JOs will return to sea duty for three years, but in a non-operational tour. In other words, they are in a sea duty billet, but not in an operational squadron. This is called a disassociated sea tour. During this tour, the JOs' records will be reviewed for selection to 04. Those not selected for 04 after two reviews, will leave the Navy within one year of failing to select the second time. Those that do select for 04 will continue their careers.

The 04s' records are then reviewed for selection to return to an operational squadron as a Department Head (DH). This thesis assumes that the 04s not selected as a Department Head will not be selected to 05, but will continue to serve in various non-operational tours until they have served 20 years, and will then leave the Navy.

If selected as a DH, the 04s will return to the FRS for refresher training following their disassociated sea tour. After refresher training, the 04s return to an operational squadron for a three year tour as a Department Head.

After three years as a squadron Department Head, the 04s return to shore duty. During that three year tour, the 04s' records are reviewed for selection to 05. If not selected to 05 after two reviews, the 04s will continue to serve in various non-operational tours until they have served 20 years, and will then leave the Navy.

The 05s' records are reviewed for selection to command one of the operational squadrons. If not selected for command, this thesis assumes they will not be selected to 06, and the 05s will serve in non-operational tours until they have served 28 years and will then leave the Navy.

If selected to command an operational squadron, the 05s will return again to the FRS for refresher training following their current shore tour. After refresher training, they arrive in the squadron as the new Executive Officer (XO). They will serve 18 months as the XO and then replace the departing Commanding Officer (CO) as the new CO. They will serve 18 months as the CO, and then leave the squadron.

With respect to this study, where the WSOs go after the squadron command tour is irrelevant. How long they remain in the Navy after command is all that is relevant.

Following the command tour, and after 20 years of service, these 05s' records will be reviewed for selection to 06. If not selected to 06, the 05s will remain in the Navy until they have served 28 years, and will then leave the Navy.

If selected to 06, they will remain in the Navy until they have served 30 years, and will then leave the Navy.

Figure 3.1 shows the possible outcomes and resulting time in service of these notional WSO career paths.

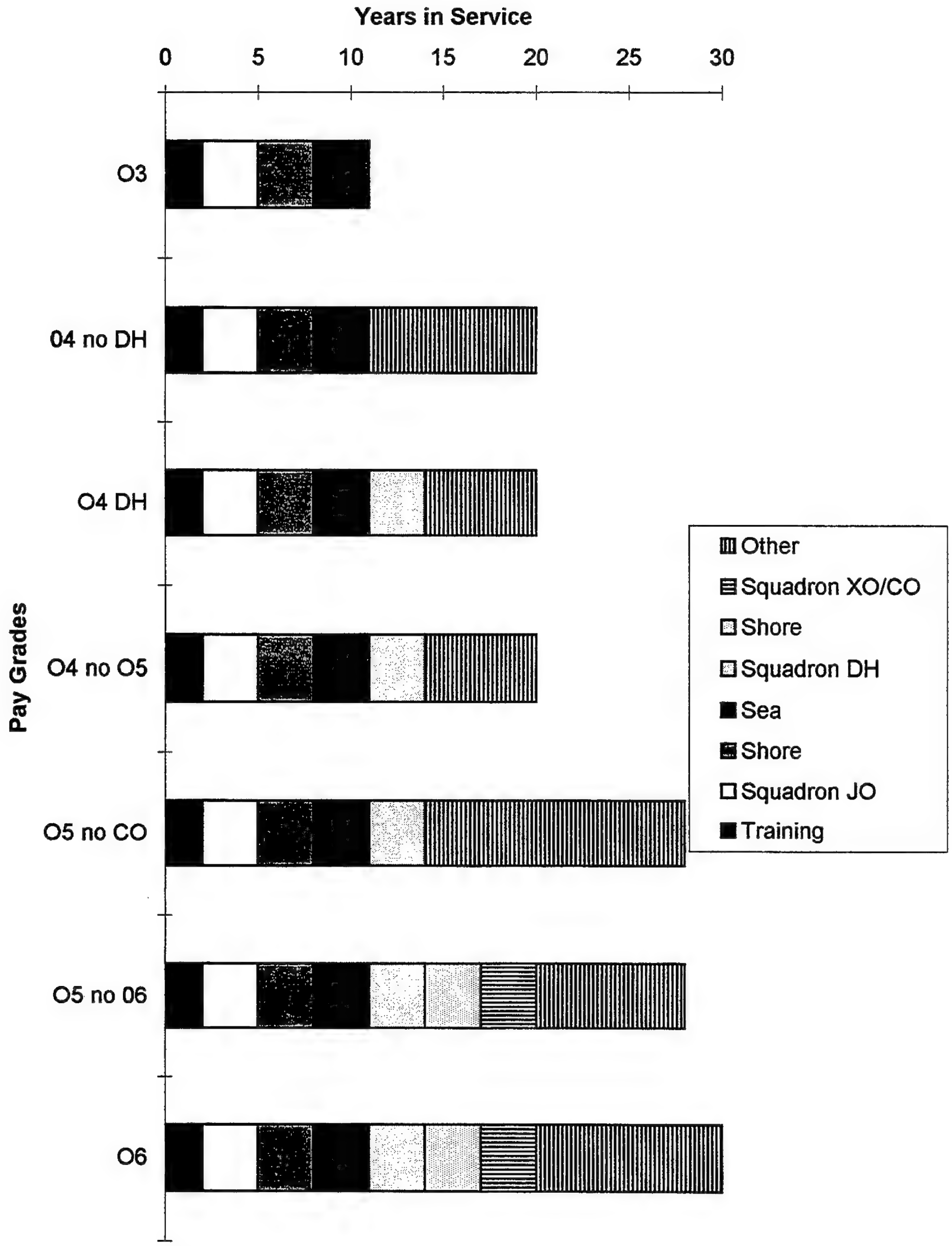

Figure 3.1. WSO Careers by Pay Grades

D. MATCHING THE CAREER PATH TO THE AIRFRAME LIFE-CYCLE

F/A-18E/F Operating and Support Life-Cycle Cost Estimate [Ref. 6] provided information concerning the predicted NFO manning of the F/A-18F squadrons. This provided the number of NFOs required for one squadron and the cost rate associated with a NFO on an annual basis. This document indicates there will be 22 WSOs in each squadron. There will be 18 JOs, three DHs, and one 05, either the XO or CO.

This study then combines the notional WSO career path with the required manning level of a F/A-18F squadron. This allowed the model to account for and include those periods in the WSO's career when they are not in an operational squadron. Figure 3.2 illustrates the rotation of WSOs through one squadron for the life-cycle of the airframe.

This flow is then combined with various assumptions, as explained later in this thesis. This combination enables one to estimate the number of WSOs required in a squadron over the 20 year life-cycle of the airframe [Ref. 20].

Finally, this study applies the results from one squadron to the planned number of transitioning squadrons. This provides the number of WSOs, and their associated costs, required to support the transition plan.

Life-Cycle Years

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XO then CO	T 1	T 1	T 2	T 2	T 2	DH T 1	DH T 1	DH T 1	DH T 2	DH T 2	DH T 2	DH T 3	DH T 3	DH T 3	JO T 1	or	JO N 1	JO N 2	JO N 2	JO N 2
DH1	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO T 1	JO T 1	JO T 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
DH2	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO T 1	JO T 1	JO T 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
DH3	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO N 1	JO N 1	JO N 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
JO 1	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 9	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 10	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 18	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7

T = Transition
N = New, via FRS

Figure 3.2. WSO Flow Through One Squadron

E. ASSUMPTIONS

1. Smoothing of Personnel Reporting and Detaching Dates

A service member's reporting date is the date he or she initially reports for duty to his or her current duty station. Conversely, their detaching date is the date they will detach from their current duty station to begin leave and travel on the way to their next duty station.

Personnel report to and detach from a squadron on virtually any day throughout the year. This is due, in part, to inherent differences in the detaching dates of personnel from their previous duty. Additionally, not all service members serve tours of the same length. For instance, although the Navy intends for aviation officers to serve three years in each tour, some members may receive orders directing a tour length other than three years. The length of assigned duty depends on many variables, including previous type and length of tour, expected type and length of next tour, and the individual's potential and timing for their next promotion. Also, not all personnel serve the exact amount of time directed in their current orders. This may be due to events in the current duty, or requirements related to their next duty. The result is personnel reporting to and detaching from a squadron on virtually all days throughout the year. Since three years of service is the Navy's intent for operational tour lengths, this study adopted it as the norm for tour lengths.

Development of a model that would accurately reflect all possible combinations of personnel reporting and detaching from a squadron would be a nearly impossible task. Therefore, this study assumes all Department Head and Junior Officer WSOs report to the squadron on the same date. Additionally, it assumes they all detach from the squadron together. This implies they also all serve an identical length tour. As previously discussed, this does not precisely reflect reality. It does maintain the required number of WSOs per squadron at all times. Therefore, it does not misstate the end total of WSOs required.

As indicated above in the WSO career path description, the CO position is a fleet-up position. That means the CO serves as the XO in the squadron immediately prior to becoming the CO. The Navy intends for the length of tour for a CO to be 18 months. The actual length of tour often varies from that by a few months, either shorter or longer. This is due to many of the same reporting and detaching factors described above. Since this command position is a fleet up position, the CO's length of tour directly determines the length of tour for his XO.

In squadrons that employ both pilots and NFOs, it is customary to alternate command of the squadron between NFOs and pilots. In general, the squadron has a pilot XO when there is a NFO CO, and vice versa. For instance, at the next change of command when the present NFO CO leaves the squadron, the pilot XO will become the new CO, and the squadron will receive a new NFO XO.

Occasionally, an interruption to this intended schedule does occur. In general, however, this is the usual pattern.

This study assumes all Executive Officers and Commanding Officers serve 18 month tours each. Their rotation dates are also aligned with the reporting and detaching dates of the DHs and JOs to simplify calculations. Furthermore, this study assumes every other XO in the XO cycle will be a WSO.

Although these assumptions do not precisely reflect reality, they do conform to the Navy's intentions and provide for a best estimate of the required number of WSOs as XO and then CO of the squadron throughout the life-cycle of the airframe. These assumptions do not lead to any material misstatement of the end result number or cost of WSOs.

2. Promotion, Retention and Separation

a. Promotions and Retention

During the development of the WSO career path, it became apparent that the promotion, retention and separation from service of these future WSOs would all be areas of considerable uncertainty. Again, the author looked to the historical performance of the F-14 RIOs for data that might be used as a predictor. Unfortunately, the Navy does not maintain statistics specific to RIOs in these areas of concern. The Office of Officer Promotion Plans stated that information of this type for the entire NFO community may be available in their data bases [Ref. 21].

Unfortunately, their workload prevented them from examining their data base, within the time available for this thesis, to determine if this information did exist. Therefore, this study uses the forecasts for promotion from the Unrestricted Line (URL) Officers promotion forecast for FY98 through FY02, approved by the Secretary of the Navy in the All Navy Notice (ALN) 81/96 [Ref. 19].

This ALN outlines the Navy's promotion intentions for URL Officers, including NFOs, in the pay grades 04 through 06. It provides information concerning the service member's time in service when considered for promotion. This study uses those lengths of time in service to estimate when WSOs will be promoted during the WSO career path.

This ALN also includes the promotion opportunity percentage for each pay grade. The promotion opportunity for a pay grade indicates the percentage of officers that will be promoted from the total considered. This study uses this percentage to estimate the selection rate of the future WSOs to their next pay grade.

Since these intentions were for all URL officers and not just NFOs or RIOs, it is likely that the actual selection timing and number of WSOs promoted will vary somewhat from the estimates used in this study. This does not affect the actual number of WSOs that will serve in operational squadrons or this study's estimate of their associated costs. It could, however, affect the number of WSOs actually in the non-operational portions of the WSO's career.

Differences might develop between the estimated number of WSOs promoted to the various pay grades versus the number actually promoted in the future. This will result in more or less WSOs in a given pay grade than estimated here. Since the number of WSOs required per pay grade in each squadron is given, such differences would only result in more or less WSOs in non-operational billets than estimated in this study. This implies there may be an increase or decrease in the actual costs associated with those non-operational WSOs versus this study's estimates.

This as an area where this study's estimates may differ from actual numbers and costs. Without historical predictive data, this study used the intentions of the Navy to predict the promotion timing and rates. Such differences therefore seem unavoidable. Such differences should be minor, and therefore do not present an opportunity to materially misstate the results.

b. Separation

One additional area of uncertainty is worthy of consideration at this point. It involves the WSO's end of service behavior. There are some Navy guidelines regarding this matter that are applicable to some of the WSOs considered in this study [Ref. 17]. Where applicable, this study applied those guidelines.

The uncertainty arises when a service member is eligible to remain in the service for some period of time, but elects to leave the service before the

maximum time allowed. To overcome this uncertainty, this study applies existing Navy guidelines without exception. This means that this study assumes each WSO will serve the maximum amount of time in service allowed for the highest pay grade obtained by the WSO.

Specifically, this study assumes all WSOs of the pay grade 03 who are not selected for the pay grade 04 will remain in the service for one year following not being selected on their second attempt. And it is assumed that all WSOs of the pay grade 04 who are not selected for the pay grade 05 will remain in the service until they complete 20 years of service. Last, this study assumes that all WSOs of the pay grade 05 who are not selected for the pay grade 06 will remain in the service until they complete 28 years of service.

The adoption of these assumptions was based primarily on the WSO's time already served when failure to select for the next pay grade occurs. Since 04s will already have 15 years in the service when they fail to select for 05, it seems reasonable to assume they would remain in the service another five years to obtain their retirement pay. Similarly, 05s will already have 21 years of service when they fail to select for 06. Although these officers are already eligible for retirement, each additional year they remain in the service equates to some increase in their retirement pay. All other things being equal, it seems reasonable to assume these officers would remain in the service the time required to obtain their maximum possible retirement pay.

As discussed, this study adopted these assumptions based primarily on the WSO's time already served when failure to select for the next pay grade occurs. There are, of course, other factors that the individuals will consider. Those factors include, but are not limited to the WSO's evaluation of the available future billets, the availability of desirable employment in the civilian sector, and a host of personal considerations. These additional considerations will undoubtedly weigh heavily in the WSO's decision to remain in the service or not. Those considerations are, however, extremely difficult, if not impossible, to assess at this time. Any prediction based upon such an assessment would be almost entirely speculation and therefore not useful in this study.

Since it seems likely that most, but probably not all WSOs will remain in the Navy for the maximum time allowable, these assumptions may potentially overstate the cost estimates developed by this study. Without reliable predictor data, any other assumption concerning these lengths of service would be speculation. As such, they would also potentially misstate the cost estimates of this study, but unpredictably. Therefore, these assumptions seem to be the best possible under the current circumstances. Additionally, while they have the potential to overstate the cost estimates of this study, any such overstatements should be minor. As such, they should not be material in quantity and therefore do not bias the results.

Finally in this section, this study assumes the maximum rank will be 06 and therefore the maximum length of service for all WSOs will be 30 years. This assumption was adopted due to an unacceptable level of uncertainty associated with the selection of Flag Officers. The requirements for Flag Officers are influenced and dictated by a host of other factors not related solely to the presence or absence of WSOs in the Navy. Many factors of far greater importance than mere availability will weigh in those decisions. In other words, it is unacceptable to assume that, just because there will be 06 WSOs available to become Flag Officers, some will be selected.

If that were the case, one could develop a predictive percentage based on historical F-14 RIO performance. The author contends that such an application of the percentages is inappropriate, for it overlooks all command, leadership and personal considerations that will weigh heavily in that selection process.

Therefore, this study avoids that uncertainty by using the above mentioned maximums. While this is done for valid reasons, it does potentially understate the cost estimates of this study. The actual costs will increase by the Flag Officers' salary rate for each WSO that attains that rank. Consideration of this implication could be the subject of research to refine these cost estimates.

3. Using One F/A-18F Squadron as the Representative

a. Returning Personnel

It is convenient when attempting to follow a squadron of WSOs through their careers and the airframe's life-cycle to concentrate on the WSOs' flowing through only one squadron. In other words, this study takes the original group of WSOs in a transitioning squadron and follows them through their careers as if that original squadron were the only operational squadron. Each time the WSOs are due to return to the fleet for an operational tour, this study assumes they will return to that original squadron. It also assumes each group of WSOs subsequent to that original group will return for all operational tours to their original squadron. This study adopted this approach to facilitate tracking multiple groups of NFOs through their careers over the entire life-cycle of the airframe.

In reality, after more than one squadron has transitioned and is operational, WSOs returning to the fleet for some subsequent operational flying tour may serve in any operational F/A-18F squadron. They will not necessarily return to the one they served in originally.

This assumption does not alter the final numbers of NFOs required during the life-cycle of the airframe. Whether the original NFOs from a transitioning squadron return to that squadron or to some other squadron for their

subsequent operational tours, each operational squadron still requires 22 WSOs. The following simplified example illustrates this principle.

Assume there are two operational F/A-18F squadrons, each with 22 WSOs. Recall that each squadron has 18 JO and three DH WSOs. When the original JOs leave the squadrons, it will be six years before any of them return as DHs. When that time arrives, only six of the 36 original JOs will return to the two squadrons as DHs. It does not matter which squadron any of those six JOs served in previously, there will still only be six returning.

The same is true for the DHs that become XOs. Of our original six DHs between the two above squadrons, only two of them will return as XOs; one for each squadron. Again, it does not matter which squadron either of them served in as DHs.

Just as this is true for two squadrons, this principle holds true no matter how many squadrons are operational. Therefore, assuming the WSOs that depart from one squadron will return to that same squadron for their future operational tours does not alter the final number of NFOs required during the life-cycle of the airframe.

b. Hours of Useful Airframe Life

One final point concerning the use of one squadron as the representative for the transition of ten squadrons deserves attention at this point. In the case of a squadron transitioning from the F-14 to the F/A-18F, the squadron

will transfer all of its F-14s before beginning transition training. Following completion of or perhaps during the later part of its transition training, the squadron will receive its complement of F/A-18Fs. This study assumes the squadron receives new aircraft at that time, with each airframe's full useful life remaining. Furthermore, it assumes the squadron will keep those airframes for the airframe's entire useful life, 20 years.

In reality, a squadron may receive used rather than new F/A-18Fs as its first complement of aircraft. It may keep these aircraft for the remainder of the airframe's useful life, or it may transfer these aircraft to some other squadron at some later time. Then, this squadron may receive new F/A-18Fs or, again, it may receive a different complement of used airframes. This practice was very common during the last transition of Naval tactical aircraft, the A-7 to the F/A-18. The receiving or transferring squadron's deployment schedule and upcoming operations tempo usually dictates such occurrences.

This study adopted the above assumptions regarding this matter for two primary reasons. First, developing a model that reflects all the possible combinations of squadron transfers and receipts is not feasible. Second, and more importantly, the Navy believes that through its aggressive fatigue life maintenance program, the F/A-18F airframes can be expected to remain in the fleet for at least their 20 year life-cycle [Ref. 20].

Each aircraft is operated until it reaches its fatigue life or until it is retired from service. An aircraft's fatigue life is set at a percentage of its design limits. The F/A-18E/F's design limits are 6000 flight hours and 2000 carrier arrestments [Ref. 20]. The hours and arrestments for each aircraft are tracked throughout each aircraft's entire life. Careful monitoring of these numbers allows the Navy to transfer the aircraft between squadrons as needed to balance periods of high tempo operations with periods of lower tempo operations. This smoothing of high and low tempo operations helps ensure that the aircraft's fatigue life is not reached prior to its 20 years of service. Because this program has been so successful in the past, the Navy is confident that the F/A-18E/F airframe will exceed its 20 year life-cycle. Therefore is seems reasonable to assume that these airframes will serve for 20 years. It is then unimportant how many different squadrons possess the airframe during those years; the number of useful years does not change. It is equally unimportant when any and all transfers occur; the total squadron-years of service remains the same.

4. Training Cost Considerations

a. Undergraduate, Graduate, and Refresher Training

The F/A-18E/F program office has not yet established the syllabus and detailed plans for the F/A-18E/F FRS [Ref. 14]. Without a WSO syllabus and training plans, it is difficult to calculate a cost to train these future WSOs. Therefore, the cost to train a F-14 RIO is used to represent the cost to train a F/A-18F WSO.

There will be two F/A-18E/F FRSs, one on each coast. The basic intention of each FRS is to train both F/A-18E pilots and F/A-18F pilots and WSOs in the same facility[7] [Ref. 14]. The Navy will modify the current F/A-18 training facilities to create the F/A-18E/F FRSs.

Since training F/A-18F crews will be an additional task of the F/A-18 FRSs and not a separate task in separate facilities, this study considers the cost to train a WSO a marginal cost. In other words, the training facilities may require some modifications, but they would still exist whether F crews were being trained or not. Although the plans to modify existing F/A-18 FRSs are not yet fully developed and cost estimates are not available, it is the opinion of the F/A-18E/F Fleet Replacement Squadron Plans office that these costs will not be major [Ref. 14]. Marginal cost takes into account that fixed costs, like those associated with the training facility itself, will not be altered as a result of training one more or one less officer. The marginal cost would be the increase, or decrease, in total training costs that occurs when one more, or one less, student is trained.

The alternative to using marginal costs would be to use the average total cost. Calculating all costs, including support costs, and dividing by the number of graduates produces average cost. It therefore prorates a portion of the fixed costs, like the training facility costs, to each student. This would falsely

[7]The author discussed the preliminary plans for the F/A-18E/F FRS with the F/A-18E/F Fleet Replacement Squadron Plans office. While the details are not yet available, the concept for the FRSs operation is currently under development.

imply that some portion of the fixed costs could be avoided if fewer students were trained. If average cost was used as the base for estimating the impact of training WSOs, the cost would be dramatically overstated. This is true since the cost of the facilities is not avoidable, whether F crews are trained or not. Therefore, the marginal cost of training WSOs seems to be the appropriate cost to use in this study.

The marginal cost to train a WSO includes all cost items attributable to one particular officer. These include the salary of the officer in training, the cost of the training flights and expended materials, and the cost of Permanent Change of Station (PCS) moves. The officer's salary includes base pay and all allowances. The cost of training flights is calculated for each type of aircraft used in training. These costs are a function of the cost per flight hour for the aircraft and the number of flight hours spent in training in that aircraft. Other training costs include the costs of expended instructional materials and the officer's flight gear. The PCS costs are an average cost of the two possible moves, from Pensacola to either the east or west coast FRS.

In 1990, William Johnson conducted a study to determine the marginal cost of training Naval Flight Officers [Ref. 16]. This study uses the results of his study, as modified below.

Johnson's study calculated costs in two major areas: Undergraduate flight training and FRS training. One component of both undergraduate and FRS

training was the student's salary. This study recalculated those salary costs to reflect today's students' salaries.[8] This was done, rather than simply adjusting those 1990 dollars to 1997 dollars, because military salaries generally have not kept pace with inflation during the 1990s. Adjusting those salaries to 1997 dollars using the standard consumers' price index adjustment would overstate those salaries.

All other costs included in Johnson's calculations are related to goods and services and therefore should be sensitive to overall economic conditions of the nation. This study adjusts those costs from 1990 dollars to 1997 dollars using a standard consumers' price index adjustment [Refs. 22 and 23].

Some costs estimated in Johnson's calculations will in fact be different in the F/A-18E/F FRS. Average hours required to train one graduate and the cost per flight hour of a F/A-18F are but two examples. Without F/A-18E/F FRS training plans and cost data, these F-14 RIO training costs provide the best available representation of the WSO training costs.

Johnson's work provides estimates for both Category I (CAT I) and Category II (CAT II) FRS trainees. Trainees receive CAT I or CAT IA training if they have never flown this type of aircraft before. Prospective F/A-18F WSOs

[8]Composite Standard Military Rates taken from the Operating and Support Life Cycle Cost Estimate for the F/A-18E/F [Ref. 6], which obtained the rates from the Defense Finance And Accounting Service Memorandum dated 01 October 1996. These composite rates include base pay, all allowances, and an allowance for the retirement annuity.

who have just graduated from undergraduate flight training will receive CAT I training. All F-14 RIOs will receive CAT IA training the first time they attend the F/A-18 FRS. The CAT II training is refresher training given to trainees returning to the fleet who have previously received CAT I or CAT IA training in this same aircraft type.

The CAT I and CAT IA training will differ only very slightly in the areas that produce FRS costs. Therefore, their FRS costs are assumed to be the same in this work.

The CAT I and II training cost estimates provided in Johnson's work include the officer's salary during training. The CAT I estimates used in this study also contain the student's salary. But this study has removed salary from the CAT IA and CAT II estimates. As is explained in a later section, this study does not include the salary of F-14 transition RIOs. It is assumed those officers would not have left the Navy immediately and therefore the Navy would have incurred the cost of their salary under either alternative. Therefore, their salary is not included in the cost estimates of this study. Removal of salary from the CAT IA and CAT II estimates facilitates calculations in this study since many CAT IA and CAT II trainees will be F-14 RIOs. The salary of CAT II WSOs who are not F-14 transitions is accounted for in other calculations. Figure 3.3 summarizes the CAT I, CAT IA and CAT II differences.

Training	Given To	Includes
CAT I	New NFOs	Undergraduate and FRS Training, includes Salary
CAT IA	First time F-14 Transitions	Just FRS Training, no salary
CAT II	Previously transitioned F-14 RIOs	Just Refresher Training, no salary
CAT II	Previously new WSOs	Just Refresher Training, salary calculated elsewhere

Figure 3.3. CAT I, CAT IA, and CAT II Training Cost Summary

It should be noted that all undergraduate and fleet replacement squadrons that instruct NFOs require NFO instructors. The undergraduate squadrons employ NFOs during their shore tours from all aircraft communities that have NFOs. The FRSs for each type of fleet aircraft employ the NFOs from that community during those NFOs' shore tours.

The implications of this decision to the F/A-18E/F vice F/A-18E FRSs of the future are fairly straightforward. Under the original decision, there would be no fleet F/A-18F WSOs to train, so there would be no WSO instructors in the FRS. Under the current decision, the fleet WSOs must be instructed, therefore there must be WSO instructors in the FRS. Those instructor billets will be filled by WSOs during their shore duties. At that time, those instructors will be a portion of the rotation base required to support this decision.

Undergraduate NFO instructor implications are equally clear. Under the original decision, there would be no fleet WSOs. With fewer fleet require-

ments for NFOs, fewer student NFOs would be present in the training squadrons. With fewer students present, fewer instructors would be required in those undergraduate squadrons. Those instructor billets currently filled by RIOs would eventually not be needed, thus equalizing the requirement for and availability of shore duty NFOs. Conversely, under the current decision, since there will be a requirement for fleet WSOs, there must be prospective WSOs in the undergraduate programs. Therefore, those training squadrons must have their share of WSO instructors, just as they have their share of RIO instructors now. Those undergraduate instructor billets will eventually be filled by WSOs on shore duty rather than RIOs on shore duty.

These undergraduate instructor WSOs, like the WSOs instructing in the FRS, will be a portion of the rotation base required to support this decision. The need for WSO instructors, whether undergraduate or FRS, was created as a result of this decision and should therefore be included with the costs associated with this decision.

b. Training Facilities

Inevitably, it will cost more to modify the existing F/A-18 FRSs into F/A-18E/F FRSs than it would have cost to modify them into F/A-18E FRSs. Since there will be more aircraft with more maintenance personnel in the F/A-18E/F FRS than there would have been in the F/A-18E FRS, the E/F FRS will likely need more hangar space. Likewise, it will need more classroom space than

a F/A-18E FRS. The Navy will also incur some additional costs to develop and install the required two-seat simulators vice simply modifying the existing single-seat F/A-18C simulators [Ref. 14].

This thesis seeks only to identify the direct costs associated with the employment, retention and training of the additionally required NFOs under the current plan. These modification costs can be associated with the requirement to train these WSOs. However, the additional modification costs are best categorized as other implementation costs related to this alternative, similar to the additional maintenance and support costs associated with the implementation of this alternative. As such, this study does not include them.

5. Transition Personnel Considerations

a. The Transition Naval Flight Officers

As the time to transition from the F-14 to the F/A-18 draws near, each transitioning F-14 squadron will begin arranging its complement of personnel. The squadron will seek a complement of personnel who will, after transition training, still be able to remain in the squadron for some significant time. Many factors will influence that length of time. Generally, the squadron's deployment schedule following the transition will be the most influential of those factors. There are no specific guidelines pertaining to this matter, as the circumstances surrounding the transition and subsequent deployment of each squadron

will be different. During the A-7 to F/A-18 transitions of the 1980s and 1990s, officers needed to be able to remain in the squadron for at least two years following transition. Without specific guidelines, this study assumes all F-14 RIOs who transition will remain in the squadron for two years following transition.

In reality, not all F-14 RIOs who transition will in fact remain in the squadron for exactly two years. Some will leave the squadron earlier than two years and some will remain for longer than two years. The actual variation from this predicted two years should not be larger than one year either shorter or longer, and, in the long run, two years should be a good average.

As previously discussed in this work, there are a multitude of factors that influence the reporting and detaching dates of personnel. Coupled with the arrangement efforts of transitioning squadrons described above, these factors will force the squadrons to transition less than their full complement of personnel. Specifically of interest to this study, the transitioning squadron will likely transition less than its full complement of 22 NFOs.

Exactly how many NFOs each of the ten F-14 squadrons will transition is unpredictable at this time. Most squadrons can arrange to transition all of the department heads and about one-half of the Junior Officers. The squadron will also generally arrange its change of command schedule such that a change of command occurs just before the transition occurs. This allows the new

CO to lead the squadron through the transition and for a few months following the transition. The XO during this CO's tour will then take over as the CO and lead the squadron during its first deployment in the new aircraft.

Since there are no established rules regarding these matters, this study uses the following assumptions, based primarily on the author's experience. This study assumes a change of command occurs just before the transition begins and that the squadron will transition it's full complement of Department Heads. Further, this study assumes one-half of the full complement of JOs will transition with the squadron.

Finally, this study assumes the FRS will supply the remainder of the JOs just before the transition begins. This provides officers to attend to the daily squadron duties while the other squadron members attend the transition training. Additionally, since these new JOs will serve a three year tour, and since the other transitioning JOs and DHs will serve one year during the transition and two years after that, the rotation dates of the DHs and JOs remain aligned.

The actual number of NFOs transitioned or obtained from the FRS by each squadron will almost certainly differ from the estimates used in this study. These estimates represent the long-run averages for the ten squadrons. The actual average should not differ from these estimates significantly and will not bias the results of the study.

b. Future Selection Implications of "Transition Groups" of Junior Officers

Each squadron will have a "transition group" of JOs, composed of nine transitioned JO RIOs and nine new JO WSOs. With ten transitioning squadrons, that is a total of 180 JO NFOs in the initial squadron complements, 90 transitioned RIOs and 90 new WSOs.

As each "transition group" of JOs progresses through its career, the members of the group will compete with one another for selection to the next pay grade and for operational squadron billets. Since there will be equal numbers of transitioned JO RIOs and new JO WSOs in each group, it is assumed that equal numbers of transitioned JO RIOs and new JO WSOs will be selected at all selection opportunities.

In other words, since the promotion opportunity for 03s to 04 is 70 percent [Ref. 19], 126 of the 180 JOs in these "transition groups" will be promoted. Of that 126, 63 will be transitioned RIOs and 63 will be new WSOs. Likewise, when it is time to select department heads, and then XO/COs, from these "transition groups," one-half of those selected will be transitioned RIOs and one-half will be former new WSOs.

The actual numbers of transitioned RIOs and new WSOs selected at various selection opportunities may differ from those estimated in this study. Given equal numbers of each JO type in the selection base, however, it seems

reasonable to assume the probability of selecting a transitioned RIO is equal to the probability of selecting a new WSO.

If more than one-half of the selections at any of the involved selection opportunities are new WSOs, the actual costs will be higher than estimated in this study. If less than one-half of the selections are new WSOs, the actual costs will be lower than estimated in this study.

6. Discounting for Radar Intercept Officers Retention Under the Original F/A-18E Plan

Recall that under the original plan, single-seat F/A-18Es would have replaced the F-14 fleet. As each squadron transitioned, the F-14 squadron's NFOs would not have transitioned since single-seat squadrons do not require NFOs. It is reasonable to assume that those NFOs would not have immediately left the Navy. Some would have transitioned to other aircraft. Others would have continued their career in various non-operational billets.

It is unknown how many of these NFOs and of what pay grades would have remained in the Navy under the original decision. It is also unknown how long each would have remained in the Navy under that decision. With no means available to determine what really would have happened to these NFOs, this study assumes they would have remained in the Navy for a time equal to the remainder of their normal career. This study determines that amount of time by continuing these NFOs' careers, through the notional career path previously outlined, to their logical conclusions. Since they would have remained in the Navy under either decision, the cost of their employment should not be considered a differential cost

attributable to this alternative. Therefore, the cost estimates of this study do not include the salaries of transitioned F-14 RIOs. Figure 3.4 reflects the effects of this assumption on the previous representation of WSO flow through a squadron, from Figure 3.2.

While the estimates of this study do not include the salaries of these F-14 RIOs, it does include the cost of their transition training. They would not have required transition or refresher training for the F/A-18 under the original single-seat alternative. The need to train them is a direct result of this decision. Therefore, those costs are estimated and included in this study.

7. Rotation Base Weapons Systems Officers

Weapons Systems Officers on shore duty will fill a large variety of billets. Several have already been mentioned in this thesis, including staff duties, ship and shore facilities' tours, and instructor tours. Furthermore, WSOs in all phases of their careers will fill such billets. This includes WSOs who are waiting to be selected for DH or XO/CO tours, WSOs in post-command tours, and WSOs who failed to select for DH or XO/CO tours or the next rank.

While justification for including the number and costs of WSOs on instructor duty in these estimates is not difficult, as previously described, justification for their inclusion while on these other tours is slightly more involved. Unfortunately, this returns us to the end strength arguments presented earlier in this thesis.

Life-Cycle Years →

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
XO then CO	T 1	T 1	T 2	T 2	T 2	DH T 1	DH T 1	DH T 1	DH T 2	DH T 2	DH T 2	DH T 3	DH T 3	DH T 3	JO T 1	or	JO N 1	JO N 2	JO N 2	JO N 2
DH1	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO T 1	JO T 1	JO T 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
DH2	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO T 1	JO T 1	JO T 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
DH3	T 1	T 1	T 2	T 2	T 2	T 3	T 3	T 3	JO N 1	JO N 1	JO N 1	JO N 2	JO N 2	JO N 2	JO N 3	JO N 3	JO N 3	JO N 4	JO N 4	JO N 4
JO 1	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 9	T 1	T 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 10	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 18	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7

Above double line are Transition F-14 RIOs.

T = Transition
N = New, via FRS

Figure 3.4. F-14 RIOs Retained Under Original Plan

If the Navy had maintained its original decision, who would have eventually filled all the shore duty billets that RIOs now fill once there were no more RIOs in the Navy? The same ambiguities and uncertainties exist when considering this issue as discussed earlier in relation to overall end strength.

In keeping with its earlier position on end strength, this thesis contends that the determination of how to fill or eliminate those billets would depend on other decisions to be made by the Navy. How the Navy would have resolved this issue will remain unknown. The availability of WSOs to fill those billets has provided a convenient and easy solution.

This study maintains that WSOs in all phases of their careers will fill these shore duty billets, regardless of whether they will ever serve in an operational squadron again or not. These WSOs would not be available to fill those billets if it were not for the decision to replace F-14s with F/A-18Fs. Therefore, their presence and cost is attributable to this decision and should be associated with the implementation of this decision. As a result, this thesis includes the relevant numbers and costs of WSOs throughout the duration of their Naval careers.

IV. PERSONNEL AND COST ESTIMATIONS

A. PERSONNEL ESTIMATIONS

This section estimates the total number of new WSOs the Navy will employ and the number of F-14 RIOs that will receive transition training.

1. Estimate of "New Weapons Systems Officers Required During Transition"

Recall that this study assumes the CO, XO, all DH NFOs and one-half of the squadron's full complement of JO NFOs will transition from the F-14. Since the F-14 NFOs would have remained in the Navy under either decision, the personnel estimates provided by this study do not include them.

The full complement of JOs in a transitioned squadron will be 18. Each transitioning squadron will receive nine, or one-half of its full complement of NFOs as new graduates from the FRS. This work refers to those NFOs as "new WSOs required during transition," since they will arrive in the squadron as the squadron enters transition training. With a total of ten F-14 squadrons transitioning, this study estimates that a total of 90 new WSOs are required during the transitions.

2. Estimate of "New Weapons System Officers Required After Transition"

After completion of transition training, the original transition group of NFOs will serve two years in the squadron, and then rotate out of the squadron.

When that rotation occurs, 18 new WSOs will arrive from the FRS. This group, and all subsequent groups of WSOs will serve three years in the squadron, and then rotate out of the squadron. Since this will occur after the transitions, this work refers to these new WSOs as "new WSOs required after transition."

Recall that all DHs and XO/COs are either transitions from the F-14 or, eventually, a result of these new WSOs. The DHs and XO/COs that transition from the F-14 are not included in the personnel estimates of this study. The DHs and XO/COs who were at one time new WSOs are accounted for when they first enter an operational squadron.

The sixth full group of 18 new WSOs would end their three year squadron tour after the 20^{th} year of the life-cycle of this airframe. This can be seen in Figure 4.1. Therefore, six full groups of 18 new WSOs will be required to complete the life-cycle of the airframe. That is 108 new WSOs required after transition, per squadron. With a total of ten F-14 squadrons transitioning, this study estimates that 1080 new WSOs are required after the transitions.

3. Total Estimated New Weapons Systems Officers Required

Combining the new WSOs required during the transitions with the new WSOs required after the transitions results in a total estimate of 1170 (90 + 1080) new WSOs required for the ten squadrons.

Life-Cycle Years →

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
JO 1			N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru			N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 9			N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 10	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
thru	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7
JO 18	N 1	N 1	N 2	N 2	N 2	N 3	N 3	N 3	N 4	N 4	N 4	N 5	N 5	N 5	N 6	N 6	N 6	N 7	N 7	N 7

N = New, via FRS

N 1 = New WSOs required **during** transition period.

N 2 thru N 7 = New WSOs required **after** transition period.

Figure 4.1. Requirement for New WSOs After Transition Period

4. Estimate of F-14 Transition Training

Figure 3.4 is helpful when considering the flow of transitioned RIOs through the squadrons.

Each squadron will transition the current CO and XO, all DHs, and one-half of the JO RIOs. Either the CO or XO will be a RIO, and one-half, or three of the DHs will be RIOs. Together with one-half, or nine, of the JOs, this means 13 RIOs will transition with each squadron as CAT IA trainees. With ten squadrons transitioning, that is a total of 130 RIOs that will receive CAT IA training.

Additionally, until such a time that new WSOs have served enough time to become DHs and XO/COs, more F-14 RIOs will be transitioned as CAT IA trainees to fill DH and XO/CO positions. Each squadron will need two more full groups of transition DHs. With three DHs in each full group, there will be 60 additional CAT IA transition RIO DHs for the ten squadrons. Each squadron will also need one more XO/CO transition RIO, for a total of ten additional XO/CO RIO transitions.

With 130 RIOs that transition with the squadrons and another 70 required for DH or XO/CO tours, there will be 200 RIOs that receive CAT IA training.

In year nine after the transition, the original transition group of JOs will be eligible for DH tours. Recall that each of these transition groups is composed of nine transitioned RIOs and nine new WSOs and that the probability of their

selection to DH is equally likely. Each squadron will have one group of three DHs in this situation. That totals 30 DHs in this situation for all ten squadrons. Therefore, 15 DHs will be previously transitioned JO RIOs and 15 will be previously new JO WSOs. This implies that 15 transitioned RIOs will receive CAT II training for these DH tours.

In year 15, a XO/CO for each squadron will be selected from the group of DHs that was previously the transition group of JOs. That totals ten such XO/COs for the ten squadrons. Those selected will receive CAT II refresher training. Again, given the equally likely probability of selection in the transition group, equal numbers of XO/COs should be selected from the RIOs and the new WSOs. Therefore, five previously transitioned RIOs will receive CAT II training before their XO/CO tours.

Finally, in years six, nine and 12, one of the previously transitioned RIO DHs will be selected for a XO/CO tour. Those selected will receive CAT II refresher training. With three such occurrences per squadron, and ten F/A-18F squadrons, there will be 30 such XO/COs.

Therefore, with 15 CAT II DHs and 35 CAT II XO/COs, there will be 50 RIOs that receive CAT II training.

5. Estimate of Total Naval Flight Officer Requirements

The total estimate of NFO requirements to man the F/A-18F fleet is 1370. This estimate includes the number of F-14 RIOs that will receive CAT IA training, and the number of new WSOs required during and after transition. This estimate is summarized in Figure 4.2.

Item	Number
F-14 RIOs for CAT IA Training	200
New WSOs required during transitions	90
New WSOs required after transitions	1080
Total	1370

Figure 4.2. Estimate of Total NFO Requirements

B. COST ESTIMATIONS

This section estimates the costs of new WSOs required during the transition period, new WSOs required after the transition period, and the transition training of F-14 RIOs. The breakdown of these costs is illustrated in Figure 4.3.

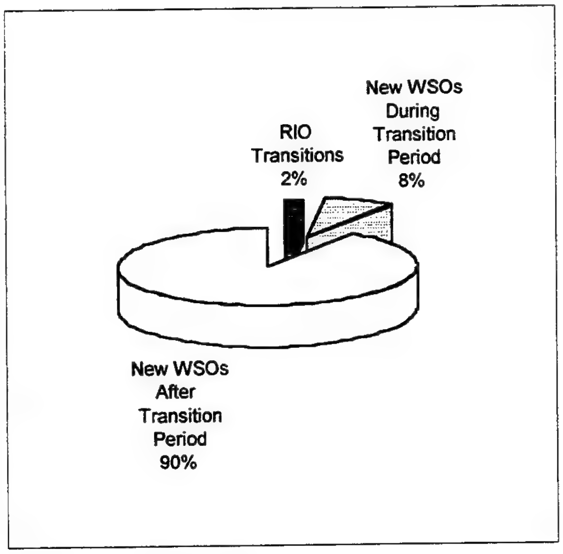

Figure 4.3. Cost Breakdown of F/A-18F NFOs

1. Promotion Opportunity and Pay Grade Salary Rates

Figures 4.4 and 4.5 present promotion opportunity and pay grade salary rate information used in the calculations of this study [Refs. 19 and 6].

Pay Grade	04	05	06
Opportunity	70 %	70 %	50 %

Figure 4.4. Promotion Opportunity to the Indicated Pay Grade

Pay Grade	Navy Annual Composite Rates FY97$
06	$125,231
05	$105,904
04	$ 89,732
03	$ 77,278
02	$ 61,193
01	$ 49,286

Figure 4.5. Annual Composite Pay Rate for the Indicated Pay Grades

2. Marginal Category I Cost

a. Marginal Cost of Weapons Systems Officers Undergraduate and Category I Graduate Flight Training

The marginal cost to train a CAT I WSO includes undergraduate and graduate training and the officer's salary during training. This cost is estimated to be $299,820. See Table A.1 in Appendix A for calculations.

b. Marginal Category IA Cost

The marginal cost to train a CAT IA WSO includes only the transition training provided by the FRS. This estimate does not include the officer's salary during training. This cost is estimated to be $186,314. See Table A.2 in Appendix A for calculations.

c. Marginal Category II Cost

The marginal cost to train a CAT II WSO includes only the refresher training provided by the FRS. This estimate does not include the officer's salary during training. This cost is estimated to be $63,091. See Table A.3 in Appendix A for calculations.

3. Estimated Cost of New Weapons Systems Officers Required During the Transition

a. Itemized Cost Estimates of New Weapons Systems Officers Required During the Transition

The promotion opportunity for 03s to 04 is 70 percent. Therefore, of the 90 new WSOs required during transition, 63 will be promoted to 04. The 27

WSOs not promoted to 04 will leave the Navy after 11 years of service at an estimated cost of $26,005,104. See Table A.4 in Appendix A for calculations.

The 63 new WSOs promoted to 04 will compete with their counterpart 63 transitioned JO RIOs for 30 department head jobs (3 DH per squadron X 10 squadrons). If among all ten squadrons, one-half of those jobs go to each group, the new WSOs and the transitioned RIOs, then 15 of the 63 new WSOs will become DHs and 48 will not. The 48 WSOs not selected to serve as DHs will remain in the Navy until they have served 20 years and then leave the Navy at an estimated cost of $85,593,312. See Table A.5 in Appendix A for calculations.

The promotion opportunity for 04s to 05 is 70 percent. Therefore, of the 15 new WSO department heads, 10.5, rounded to ten, will be promoted to 05 and five will not. The five not promoted to 05 will remain in the Navy until they have served 20 years, and then leave the Navy at an estimated cost of $9,231,425. See Table A.6 in Appendix A for calculations.

These ten new WSO 05s will compete with their ten counterpart transitioned RIOs for command of one of the ten squadrons. If among all ten squadrons, one-half of those jobs go to each group, five commands should go to the new WSOs and five commands should go to the transitioned RIOs. Of these ten new WSO 05s then, five will command a squadron, five will not. The five new WSO 05s that do not command a squadron will remain in the Navy until they

have served 28 years, and then they will leave the Navy at an estimated cost of $13,871,885. See Table A.7 in Appendix A for calculations.

The promotion opportunity for 05s to 06 is 50 percent. Therefore, of the five new WSO 05s that command a squadron, two and one-half, rounded to two, of these new WSOs will be promoted to 06. The three 05s not promoted to 06 will remain in the Navy until they have served 28 years, and then they will leave the Navy at an estimated cost of $8,512,404. See Table A.8 in Appendix A for calculations.

The two WSOs promoted to 06 will remain in the Navy until they have served 30 years, and then they will leave the Navy at an estimated cost of $6,446,438. See Table A.9 in Appendix A for calculations.

b. Total Estimated Cost of New Weapons Systems Officers Required During Transition

The total estimated cost of the 90 new WSOs required during the transitions is $148,660,577. Figure 4.6 compiles the itemized costs from above to arrive at this estimate.

Number	Item	Cost
27	WSOs not promoted to 04	$ 26,005,104
48	04 WSOs not selected to serve as DHs	$ 85,593,312
5	04 DHs not promoted to 05	$ 9,231,425
5	05s that do not command a squadron	$ 13,871,885
3	05s not promoted to 06	$ 8,512,404
2	WSOs promoted to 06	$ 6,446,438
90	Total	$148,660,577

Figure 4.6. Cost Estimate for New WSOs Required During Transition

4. Estimated Cost of New Weapons Systems Officers Required After Transitions

a. *Itemized Cost Estimates of New Weapon Systems Officers Required After Transitions*

The promotion opportunity for 03s to 04 is 70 percent. Therefore, of the 1080 new WSOs required after transition, 756 will be promoted to 04. The 324 WSOs not promoted to 04 will leave the Navy after 11 years of service at a estimated cost of $312,061,248. See Table A.10 in Appendix A for calculations.

The 756 new WSOs promoted to 04 will compete for 90 department head jobs (3 DH per squadron X 3 DH rotations X 10 squadrons). The three DH rotations can be seen in Figure 4.7. The 666 WSOs not selected to serve as DHs will remain in the Navy until they have served 20 years, and then leave the Navy at an estimated cost of $1,187,607,204. See Table A.11 in Appendix A for calculations.

The promotion opportunity for 04s to 05 is 70 percent. Therefore, of the 90 department heads, 63 will be promoted to 05 and 27 will not. The 27 not promoted to 05 will remain in the Navy until they have served 20 years, and then leave the Navy at an estimated cost of $49,849,695. See Table A.12 in Appendix A for calculations.

These 63 05 WSOs will compete for command of one of the ten squadrons. There will be one command rotation during their careers. These

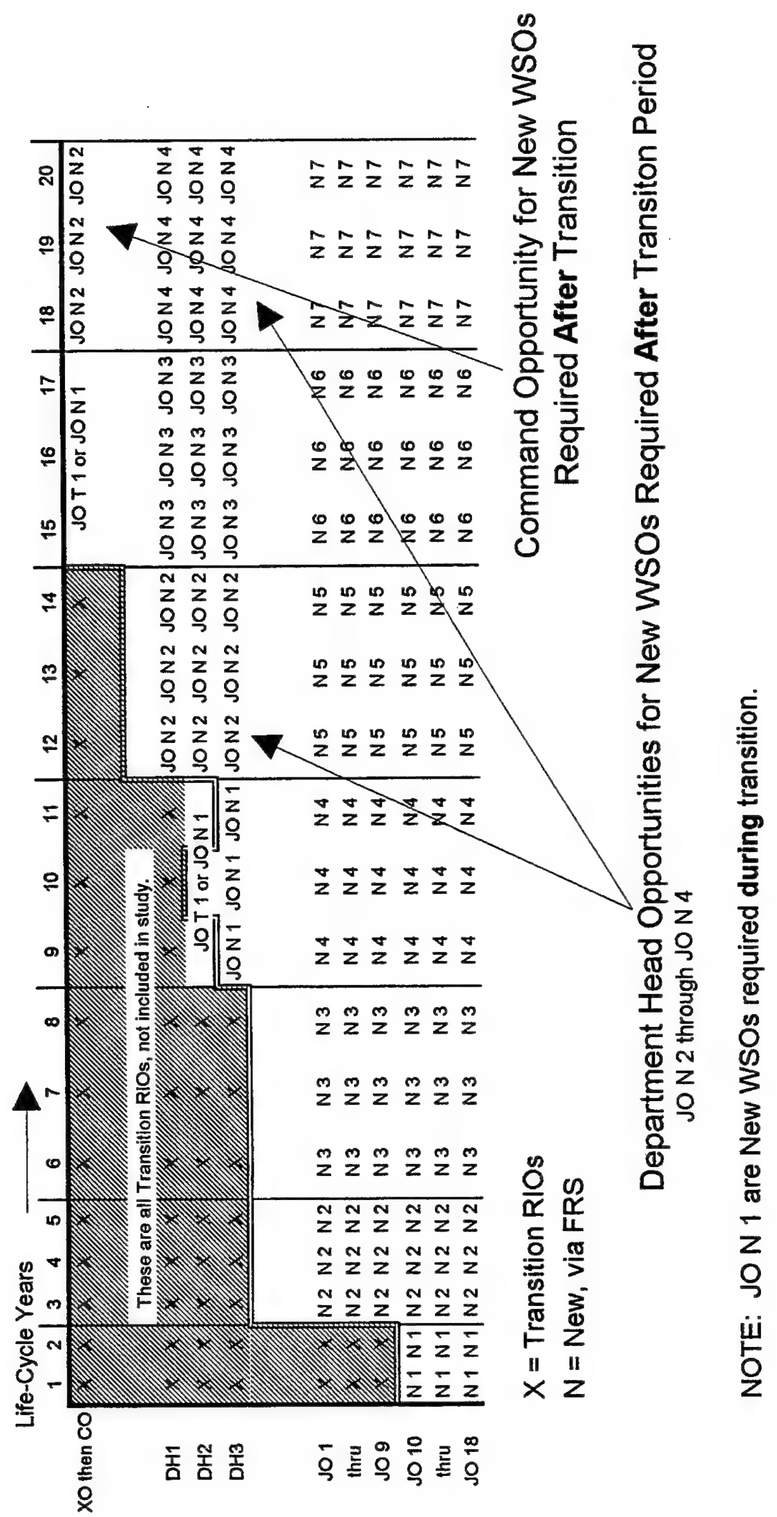

Figure 4.7. DH and XO/CO Opportunities for New WSOs After Transition Period

command rotations can also be seen in Figure 4.7. Therefore, ten (1 rotation X 10 squadrons) of these WSOs will command a squadron, and 53 will not. The 53 WSOs that do not command a squadron will remain in the Navy until they have served 28 years, and then they will leave the Navy at an estimated cost of $160,501,781. See Table A.13 in Appendix A for calculations.

The promotion opportunity for 05s to 06 is 50 percent. Therefore, of the ten WSOs that command a squadron, five of these WSOs will be promoted to 06. The five 05s not promoted to 06 will remain in the Navy until they have served 28 years, and then they will leave the Navy at an estimated cost of $14,187,340. See Table A.14 in Appendix A for calculations.

The five WSOs promoted to 06 will remain in the Navy until they have served 30 years, and then they will leave the Navy at an estimated cost of $16,116,095. See Table A.15 in Appendix A for calculations.

b. Total Estimated Cost of Weapons Systems Officers Required After Transition

The total estimated cost of the WSOs required after the transitions is $1,740,323,363. Figure 4.8 compiles the itemized costs from above to arrive at this estimate.

Number	Item	Cost
324	WSOs not promoted to 04	$ 312,061,248
666	WSOs not selected to DH	$1,187,607,204
27	DHs not promoted to 05	$ 49,849,695
53	05 WSOs not selected to command	$ 160,501,781
5	05s not promoted to 06	$ 14,187,340
5	WSOs promoted to 06	$ 16,116,095
1080	Total	$1,740,323,363

Figure 4.8. Cost Estimate of WSOs Required After Transition

5. Total Estimated Cost of New Weapons Systems Officers Required

The total estimated direct costs of new WSOs required to support the F/A-18F replacement of the F-14 fleet, obtained from Figures 4.6 and 4.8 above, is $1,888,983,940. This estimate is itemized in Figure 4.9.

Number	Item	Cost
90	New WSOs required during transitions	$ 148,660,577
1080	New WSOs required after transitions	$1,740,323,363
1170	Total	$1,888,983,940

Figure 4.9. Total Cost Estimate of New WSOs Required

6. Estimated Transition Training Costs of F-14 Radar Intercept Officers

a. Estimated Category IA Training Costs

The total CAT IA training costs of F-14 RIOs is estimated to be $37,262,800. See table A.16 in Appendix A for calculations.

b. Estimated Category II Training Costs

The total CAT II training costs of F-14 RIOs is estimated to be $3,154,550. See table A.17 in Appendix A for calculations.

c. Total Estimated Training Costs

The total training costs of F-14 RIOs is estimated to be $40,417,350. This estimate is itemized in Figure 4.10.

Item	Cost
CAT IA Training	$37,262,800
CAT II Training	$ 3,154,550
Total	$40,417,350

Figure 4.10. Total Estimate of F-14 RIO Training Costs

7. Total Estimated Cost of F/A-18F Naval Flight Officers

The total estimated cost of all F/A-18F NFOs required for ten squadrons over the 20 year life-cycle of the airframe, obtained from Figures 4.9 and 4.10 above, is $1,929,401,290. This estimate is itemized in Figure 4.11.

Item	Cost
Estimated Cost of New WSOs	$1,888,983,940
Estimated Cost of F-14 RIO Training	$ 40,417,350
Total	$1,929,401,290

Figure 4.11. Total Estimated Cost of F/A-18F NFOs

Therefore, the recent decision by the Navy to transition F-14 squadrons to F/A-18F squadrons will result in an additional cost to the Navy of $1.93 billion over the life-cycle of the new airframe. The $1.93 billion is expressed in FY97 dollars. Pay raises and inflation over the life-cycle will increase that figure substantially.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This study was undertaken to estimate the number of required NFOs and their associated costs resulting from the decision to shift from the F/A-18E to the F/A-18F as the replacement for the F-14. The estimated costs are those directly associated with the employment, retention and training of those NFOs. The results clearly show that the numbers and costs associated with this portion of the F/A-18F fleet are not trivial. The estimated cost is $1.93 billion.

These estimates are based on 100 percent manning levels for the squadrons. Since squadrons are seldom manned to 100 percent levels, the actual costs should be somewhat less than these estimates. However, the estimates are in constant FY97 dollars. Therefore, the effects of inflation and salary increases have not been included.

Additionally, when considering the relative magnitude of these costs, one must keep in mind that these costs are only a portion of the additional costs that the Navy will incur as a result of this decision. Other additional costs are related to the F/A-18F airframe, the maintenance and support requirements, the modifications to the training facilities and the additional enlisted personnel required to maintain the F/A-18F fleet. Identification of the costs in each of these areas are topics for further research.

This study addressed the analytical issues associated with determining the additional personnel requirements and their costs. When attempting to determine the effects of increases in personnel requirements for one community on overall Navy end strength, it is arguable whether such increases really result in an increase in end strength or not. If such increases in community requirements do not increase end strength, then it might be argued that the Navy would have incurred these costs under either alternative and therefore, there is not a differential cost. This may be true in the short-run. But in the long-run, end strength is a function of requirements and should therefore be sensitive to increases or decreases in the requirements for individual communities. While the ultimate effect on end strength would be the result of many other decisions, certainly the retention of these F-14 RIOs and the accession of these new WSOs will become one of the determinants of end strength. As such, their costs must be identified.

While this study only considers one portion of the results of a decision already made, its dynamic method broadens the scope of possible future comparisons between alternatives for decision makers. The dynamic method developed in this study not only considers the NFOs in the squadrons, but includes all NFOs required to implement this decision. It also considers the dynamics of change that will occur over time as F-14 RIOs transition to the F/A-18F. This dynamic method provides a better estimate of the direct personnel costs than a static method which considers only "point in time" annual costs.

Better estimates of such costs could result in better cost-effectiveness analyses. While costs are certainly not the only consideration in such comparisons, the comparisons should include the best available estimate of the dollar costs resulting from the decision.

B. RECOMMENDATIONS

This study recommends that the Navy continue to refine the methods of estimation developed in this study. A refined version of the method developed in this study could provide future decision makers with improved estimates in the areas of personnel and their costs for the implementation of an alternative.

There are many areas in this thesis which require further study. Several have already been mentioned in these conclusions, including the identification of FRS modification costs and FRS training costs and inclusion of the effects of inflation and salary increases. In addition to these areas, there are other items whose identification would refine the estimates of this study. These areas include the accession costs of additional NFO candidates, the actual retention, promotion and separation statistics of RIOs and WSOs, and a determination of actual WSO manning levels in the fleet.

APPENDIX A - CALCULATION TABLES

Table A.1. CAT I WSO Marginal Cost

Item	Totals
1990 Total Marginal Cost	$ 216,497
- 1990 24 months Salary	$(48,790)
= 1990 Non-Salary Cost[9]	$ 167,707
+ 1990 to 1996 CPI Adjustment[10]	$ 33,541
= 1997 Non-Salary Cost	$ 201,248
+ 1997 24 months Salary[11]	$ 98,572
= 1997 Total Marginal Cost	$ 299,820

Table A.2. CAT IA Marginal Training Cost

Item	Totals
1990 FRS CAT I Cost	$155,262
+ 1990 to 1996 CPI Adjustment[12]	$ 31,052
= 1997 Total Marginal Cost	$186,314

---

[9] 1990 CAT I Non-Salary Costs = $9,420 Undergraduate training costs + $3,025 PCS costs + $155,262 FRS costs.

[10] CPI Adjustment: 1990 CPI = 130.7 (1982-1984 = 100)

1996 CPI = 156.9

Change = 26.2

% Change = 26.2 / 130.7 = 20.0 %

20.0 % of 167,707 = 33,541

Method taken from Gwartney, J.D., and Stroup, R.L. [Ref. 24].

[11] FY97 Navy Annual Composite Rates contain an allowance for the retirement annuity not included in the 1990 salary.

[12] CPI Adjustment: As above, then: 20.0 % of 155,262 = 31,052

Table A.3. CAT II Marginal Training Cost

Item	Totals
1990 FRS CAT II Cost	$52,576
+ 1990 to 1996 CPI Adjustment[13]	$10,515
= 1997 Total Marginal Cost	$63,091

Table A.4. WSOs Required During Transition
WSOs Not Promoted to 04

Item	Equation	Cost
27 WSOs X CAT I Training	27 X $299,820	$ 8,095,140
27 WSOs X 2 years at 02	27 X (2 X $61,193)	$ 3,304,422
27 WSOs X 7 years at 03	27 X (7 X $77,278)	$14,605,542
	Total	$26,005,104

Table A.5. WSOs Required During Transition
04 WSOs Not Selected to DH

Item	Equation	Cost
48 WSOs X CAT I Training	48 X $299,820	$14,391,360
48 WSOs X 2 years at 02	48 X (2 X $61,193)	$ 5,874,528
48 WSOs X 6 years at 03	48 X (6 X $77,278)	$22,256,064
48 WSOs X 10 years at 04	48 X (10 X $89,732)	$43,071,360
	Total	$85,593,312

[13] CPI Adjustment: As above, then: 20.0 % of 52,576 = 10,515

Table A.6. WSOs Required During Transition
DHs Not Promoted to 05

Item	Equation	Cost
5 WSOs X CAT I Training	5 X $299,820	$1,499,100
5 WSOs X 2 years at 02	5 X (2 X $61,193)	$ 611,930
5 WSOs X 6 years at 03	5 X (6 X $77,278)	$2,318,340
5 WSOs X CAT II DH Training	5 X $63,091	$ 315,455
5 WSOs X 10 years at 04	5 X (10 X $89,732)	$4,486,600
	Total	$9,231,425

Table A.7. WSOs Required During Transition
05s Not Selected for Command

Item	Equation	Cost
5 WSOs X CAT I Training	5 X $299,820	$ 1,499,100
5 WSOs X 2 years at 02	5 X (2 X $61,193)	$ 611,930
5 WSOs X 6 years at 03	5 X (6 X $77,278)	$ 2,318,340
5 WSOs X CAT II DH Training	5 X $63,091	$ 315,455
5 WSOs X 5 years at 04	5 X (5 X $89,732)	$ 2,243,300
5 WSOs X 13 years at 05	5 X (13 X $105,904)	$ 6,883,760
	Total	$13,871,885

Table A.8. WSOs Required During Transition
Command 05s Not Selected to 06

Item	Equation	Cost
3 WSOs X CAT I Training	3 X $299,820	$ 899,460
3 WSOs X 2 years at 02	3 X (2 X $61,193)	$ 367,158
3 WSOs X 6 years at 03	3 X (6 X $77,278)	$1,391,004
3 WSOs X CAT II DH Training	3 X $63,091	$ 189,273
3 WSOs X 5 years at 04	3 X (5 X $89,732)	$1,345,980
3 WSOs X CAT II XO/CO Training	3 X $63,091	$ 189,273
3 WSOs X 13 years at 05	3 X (13 X $105,904)	$4,130,256
	Total	$8,512,404

Table A.9. WSOs Required During Transition
06 WSOs

Item	Equation	Cost
2 WSOs X CAT I Training	2 X $299,820	$ 599,640
2 WSOs X 2 years at 02	2 X (2 X $61,193)	$ 244,772
2 WSOs X 6 years at 03	2 X (6 X $77,278)	$ 927,336
2 WSOs X CAT II DH Training	2 X $63,091	$ 126,182
2 WSOs X 5 years at 04	2 X (5 X $89,732)	$ 897,320
2 WSOs X CAT II XO/CO Training	2 X $63,091	$ 126,182
2 WSOs X 6 years at 05	2 X (6 X $105,904)	$1,270,848
2 WSOs X 9 years at 06	2 X (9 X $125,231)	$2,254,158
	Total	$6,446,438

Table A.10. WSOs Required After Transition
WSOs Not Promoted to 04

Item	Equation	Cost
324 WSOs X CAT I Training	324 X $299,820	$ 97,141,680
324 WSOs X 2 years at 02	324 X (2 X $61,193)	$ 39,653,064
324 WSOs X 7 years at 03	324 X (7 X $77,278)	$175,266,504
	Total	$312,061,248

Table A.11. WSOs Required After Transition
04 WSOs Not Selected to DH

Item	Equation	Cost
666 WSOs X CAT I Training	666 X $299,820	$ 199,680,120
666 WSOs X 2 years at 02	666 X (2 X $61,193)	$ 81,509,076
666 WSOs X 6 years at 03	666 X (6 X $77,278)	$ 308,802,888
666 WSOs X 10 years at 04	666 X (10 X $89,732)	$ 597,615,120
	Total	$1,187,607,204

Table A.12. WSOs Required After Transition
04 DHs Not Promoted to 05

Item	Equation	Cost
27 WSOs X CAT I Training	27 X $299,820	$ 8,095,140
27 WSOs X 2 years at 02	27 X (2 X $61,193)	$ 3,304,422
27 WSOs X 6 years at 03	27 X (6 X $77,278)	$12,519,036
27 WSOs X CAT II DH Training	27 X $63,091	$ 1,703,457
27 WSOs X 10 years at 04	27 X (10 X $89,732)	$24,227,640
	Total	$49,849,695

Table A.13. WSOs Required After Transition
05 WSOs Not Selected for Command

Item	Equation	Cost
53 WSOs X CAT I Training	53 X $299,820	$ 15,890,460
53 WSOs X 2 years at 02	53 X (2 X $61,193)	$ 6,486,458
53 WSOs X 6 years at 03	53 X (6 X $77,278)	$ 24,574,404
53 WSOs X CAT II DH Training	53 X $63,091	$ 3,343,823
53 WSOs X 5 years at 04	53 X (5 X $89,732)	$ 37,238,780
53 WSOs X 13 years at 05	53 X (13 X $105,904)	$ 72,967,856
	Total	$160,501,781

Table A.14. WSOs Required After Transition
Command WSOs Not Promoted to 06

Item	Equation	Cost
5 WSOs X CAT I Training	5 X $299,820	$ 1,499,100
5 WSOs X 2 years at 02	5 X (2 X $61,193)	$ 611,930
5 WSOs X 6 years at 03	5 X (6 X $77,278)	$ 2,318,340
5 WSOs X CAT II DH Training	5 X $63,091	$ 315,455
5 WSOs X 5 years at 04	5 X (5 X $89,732)	$ 2,243,300
5 WSOs X CAT II XO/CO Training	5 X $63,091	$ 315,455
5 WSOs X 13 years at 05	5 X (13 X $105,904)	$ 6,883,760
	Total	$14,187,340

Table A.15. WSOs Required After Transition
06 WSOs

Item	Equation	Cost
5 WSOs X CAT I Training	5 X $299,820	$ 1,499,100
5 WSOs X 2 years at 02	5 X (2 X $61,193)	$ 611,930
5 WSOs X 6 years at 03	5 X (6 X $77,278)	$ 2,318,340
5 WSOs X CAT II DH Training	5 X $63,091	$ 315,455
5 WSOs X 5 years at 04	5 X (5 X $89,732)	$ 2,243,300
5 WSOs X CAT II XO/CO Training	5 X $63,091	$ 315,455
5 WSOs X 6 years at 05	5 X (6 X $105,904)	$ 3,177,120
5 WSOs X 9 years at 06	5 X (9 X $125,231)	$ 5,635,395
	Total	$16,116,095

Table A.16. F-14 RIO CAT IA Training Costs

Item	Equation	Cost
130 transition RIOs	130 X $186,314	$24,220,820
10 additional XO/CO RIO	10 X $186,314	$ 1,863,140
60 additional DH RIO	60 X $186,314	$11,178,840
	Total	$37,262,800

Table A.17. F-14 RIO CAT II Training Costs

Item	Equation	Cost
15 RIOs for DH tours	15 X $63,091	$ 946,365
5 RIOs for XO/CO tours	5 X $63,091	$ 315,455
30 RIO DHs for XO/COs	30 X $63,091	$1,892,730
	Total	$3,154,550

APPENDIX B. ACRONYMS AND ABBREVIATIONS

ADM	Acquisition Decision Memorandum
ALN	All Navy Notice
BN	Bombardier Navigator
CAT I	Category I
CAT IA	Category IA
CAT II	Category II
CINC	Commander in Chief
CO	Commanding Officer
COEA	Cost and Operational Effectiveness Analysis
DH	Department Head
DOD	Department of Defense
EMD	Engineering and Manufacturing Development
FRS	Fleet Replacement Squadron
GAO	General Accounting Office
JO	Junior Officer
JSF	Joint Strike Fighter
NFO	Naval Flight Officer
ORD	Operational Requirements Document
P3I	Preplanned Product Improvements
PCS	Permanent Change of Station
POM	Project Objective Memorandum
RIO	Radar Intercept Officer
URL	Unrestricted Line
WSO	Weapons Systems Officer
XO	Executive Officer

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4. Prof. John E. Mutty (Code SM/Mu)..1
   Naval Postgraduate School
   Monterey, CA 93943-5103

5. Prof. Katchan Terasawa (Code SM/Tk)..1
   Naval Postgraduate School
   Monterey, CA 93943-5103

6. Robert A. Hunt..2
   17693 Iona Ave.
   Lemoore, CA 93245